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ELECTRICAL REVIEW.

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NEUTRALITY AND THE MORAL LAW.

THANKS to the labours of the pre-historian and the historian, we are able to trace with tolerable accuracy the path along which mankind has advanced both in his material and his moral development.

Some fifty thousand years separates the civilisation of palæolithic man from that of to-day, and the advance made during that period in man's knowledge of material things, and in the sphere of morals, has been immense. In the earlier part of this period the rate of progress was slow owing to the sparse distribution of the population and the difficulties in sustaining life. During the last few thousand years, however, the physical and mental environment of man has changed very rapidly, and this change in environment has in itself provided an atmosphere congenial to the birth of new ideas.

One of the chief factors in promoting progress has been the increased intercourse and co-operation between the various sections into which the human race is divided. New and rapid means of travel and communication have been created, systematic education has become general, and a daily interchange of ideas now sweeps freely over every quarter of the globe.

Our world has at once widened and contracted; it has widened, in that our knowledge and interests now extend to the utmost confines of the earth, and it has contracted since our thoughts and acts may now be known throughout the world almost at the moment of their birth.

This transformation, wrought largely by the magic of the engineer, has had, and will have increasingly in the future, a vast influence upon the moral as well as upon the material progress of mankind.

We can trace in the past the effect of the progressive widening of the mental and material horizons on the moral and material progress of the race.

These horizons were very restricted when the family of the nomad hunter formed the collective unit, they widened slowly, as first settlements, and then peoples, and nations came into being, until to-day, with our world-wide horizon, we are awakening to the consciousness of the unity of our Race, and feel within us the pulsing of the heart of Humanity.

In the material world the achievements and advances gained by man in his struggle with Nature have become the common property of the peoples of the earth, and in like manner, in the sphere of morals, a common store of ideals and moral obligations has been built up.

In this day of thunderous stress, amid the clash and shock of material conflict, it is difficult for us to realise as clearly as we should do, that the real issue that is being fought out in the bloody mire of Flanders and the stained snows of Poland is not a material one; it is a conflict between human ideals, the result of which will determine for many centuries to come the moral progress or retrogression of our race.

To what end is this fearful flood of blood and destruction poured out, sweeping away with it the hallowed sanc-

tuaries, the garnered treasures, and the sweet amenities of a Continent, annihilating the spirit of its past, blasting the promise of its future and bringing woe and life-long tears to millions of our fellow men? In two words, it is as to whether Force or Freedom is to govern the future of our race, whether brute force is to be king, or whether the right of humanity freely to follow its ideals and the dictates of the Moral Law is to be paramount.

The German people, under the influence of its teachers, philosophers and military leaders, have come to believe in the Gospel of Force, and to think that the laws of Force govern the moral and material progress of mankind. There does not appear to be any sound biological basis for such a law when applied to mankind. Huxley showed us more than a generation ago that Man can, and does, cut athwart the laws of purely natural development, and that Nature "red in tooth and claw" is not only faced, but is mastered, by the spirit of Man.

Man is shaping his destiny in accordance with spiritual laws, he sets up a standard unknown to Nature, and one which it is beyond the power of Force to overwhelm. Whatever the ultimate fate of the race may be, there is no mistaking its present duty, the call is clear and high. What of the response?

The Teuton peoples fight for the right of Might; the Allies fight for Freedom; and the rest of the world is "Neutral." Neutral they may be so far as active participation in the material conflict is concerned, but what neutrality can there be in connection with the moral issues of the struggle?

It is evident that the material concerns of certain peoples are more closely involved in the present strife than are those of other nations more remote from the scene of conflict, but the moral issues indubitably and intimately concern the whole of the human race. For these issues the attitude of "neutrality" can only be a negative one, a passive waiting for the decision of the issue by others, and a flaccid acceptance of the ideals of the victor. Do the "Neutrals" recognise that their wills are only temporary manifestations of an ampler will, that their lives are passing phases of a larger life; if they hold themselves aloof, can they hope to wear the Crown Divine, the harvest of our blood and tears?

America should know; for Emerson has taught her that every spirit builds itself a house, and beyond its house a world, and beyonds its world a heaven, but only what she herself *is* can she really know and see. Is she prepared to sit silent and inactive in the land of Freedom while the world-building is done by other hands?—is the chinking of the almighty dollar so loud in her ears as to drown the still small voice of the All-Father of her race? We trust not, we think not, but she, with other "Neutrals," would do well to ponder the moral obligations they took upon themselves at the Hague in 1907 and to prepare to discharge them, for they still await discharge.

If we are to entertain any hope of the elimination of military domination in the near future, such hope can only be based upon the collective action of the race in the present crisis. The solemn obligations accepted by the Powers signing the Hague Convention must be upheld, must be discharged, or the Powers concerned must for ever be marked with the stigmata of dishonour and the brand of cowardice.

What shall it profit a nation if she gain the whole world and lose her own soul?

Copper.

There has been a continued and sustained demand for copper from the consuming trades, alike in this country, France, and the United States, and there has not been any yielding in the position of the leading producers, who have of late made such substantial sales that they are in a pretty comfortable position for some weeks to come. That a considerable amount of confidence is felt that the domestic trade across the Atlantic which has been in a languishing condition for a long time . . . a condition which is far more responsible for the complaints made as to the miserable state of the United States copper trade than is the British declaration that copper is contraband . . . is on the eve of solid improvement, goes without saying. It is high time that there was an extension of business enterprise there, and some signs of the stirring of the dry bones is indeed perceptible already. There has been a certain amount of reawakening of interest in the Stock Exchange in New York, and this usually betokens that the keener-witted element has scented something moving, and in view of the long depression it is out of the question that there should be any further contraction in the tonnage of general business passing. The European War has released immense orders for the British, French, and other allied Governments, which have put many branches of United States industrial effort upon a more active basis than has been experienced for years, and there can be no let-up in this direction until the Huns are finally smashed and their powers for further evil utterly demolished for a century to come.

Naturally, coming on top of a curtailment of production estimated at 50 per cent. of the refinery capacity, copper has sustained a considerable advance within recent weeks, and is still firmly held at about the top figures, but the price is now sufficiently advanced to stimulate production, and accordingly it is no matter for surprise to find that many of the largest mines in the United States have resumed normal working, and that others are following suit in all directions. The process of output restriction has indeed ceased to exist so far as the Lake Superior mines are concerned, and production has assumed an entirely normal appearance. This can only be the prelude to easier market conditions for copper sooner or later, for there can be no question but that it pays handsomely to turn out refined metal at round current selling prices. For this reason there is a disposition to take a rather conservative view of the future, and consumers have lately been only buying in strict relation to their needs and to the prospective orders. The immediate position seems to be firmly established enough, but excessive optimism as to the situation of prices might be unwise as regards the second half of the year.

Trans-Continental Telephony.

Considerable space has been devoted by our American contemporaries to the triumphant achievement of telephonic communication between San Francisco, on the Pacific coast of North America, and New York, Boston, and Washington on the Atlantic sea-board, a feat upon which they are entitled to our hearty congratulations. A specially noteworthy feature of the occasion was the fact that Prof. Alexander Graham Bell spoke with Mr. T. A. Watson over the 3,400-mile line, these gentlemen having been the first to hold conversation with the telephone invented by the former in 1876; moreover, they successfully used Dr. Bell's original transmitter for this purpose, and we cordially congratulate the inventor upon being privileged to witness this magnificent consummation of his pioneering work of 49 years ago. What would Faraday have said if he could have seen a modern 25,000-kw turbo-generator, the gigantic offspring of his creative genius?

The credit for overcoming the many engineering difficulties met with in the construction of the intra-oceanic line is ascribed to Mr. John J. Carty, chief engineer of the American Telephone and Telegraph Company; the commercial problems of finance and organisation were dealt with by Mr. Theodore N. Vail, president of the company. Some particulars of the line are given elsewhere in this issue. It is interesting to note that by special connections to the home of Mr. Vail, conversation was successfully carried on *viâ* Boston over a total distance of no less than 4,750 miles. We must not omit to mention that the feat was rendered possible by the use of the loading coils invented by Prof. Michael Pupin, of Columbia University, who, we have no doubt, would readily admit his indebtedness to the mathematical researches of our fellow-countryman, Dr. Oliver Heaviside, in this connection.

HAND REGULATION OF A HYDRO-ELECTRIC PLANT IN INDIA.

By J. W. MEARES.

In these days of automatic regulation, distant control, and so forth, it may be of interest to readers of the Electrical Review to hear of a water-driven power station which has for years been regulated entirely by hand, without governors.

The plant in question is at Darjeeling, the hill station of Bengal, and the summer headquarters of the Bengal Government. The original installation was laid down by the present writer in 1896, on behalf of Messrs. Kilburn and Co., in pursuance of an agreement with the municipality. It consisted of two 65-kw. Crompton-Brunton single-phase alternators, driven by Gunther Girard turbines. Soon after completion a disastrous flood caused a landslide which dammed up one of the two hill torrents which supplied the power, with the result that the power station was buried in mud over the top of the machines. They were excavated, however, washed and dried, and set to work again some few weeks later. These 2,300-volt generators are still working, and as an old Cromptonian I feel rather proud of them.

The present municipal engineer, Mr. G. P. Robertson,* M.I.E.E., M.I.Mech.E., took over charge in 1903, and under his able management this small plant has been extended from time to time, and has paid very well indeed. Incidentally, he adopted a "point-five" tariff for the winter heating load many years ago—earlier, I think, than our friends in Great Britain. From the very beginning, even before the mud episode, the hydraulic governors were very troublesome; they were not of a type calculated to assist in the parallel running of alternators, and they never recovered from the shock of being buried alive.

From this point I prefer Mr. Robertson's report, on the extension now contemplated, to speak for itself.

"The governors on the old machines gave so much trouble that they have been scrapped, and the machines are being controlled by hand. One of the difficulties was grit getting into the governor-controlled valves of the hydraulic gear. Oil-pressure gear was, therefore, specified for the new turbine, and the governor supplied acted splendidly for a time. One day, however, the machine started hunting so violently that it had to be shut down, but when opened out again it ran as smoothly as if nothing had happened.

"Some time afterwards I was in the power house when the same thing occurred again. I then thought that the effect was due to an electrical surge of such a nature as to set up mechanical pulsations, synchronising in some way with the surge, so that the machine was nearly hammered to pieces before it could be shut down.

"I made inquiries about this while at home this year, and heard of several similar cases, though very little is said about them. One man explained the case as being due to harmonics; he admitted that similar cases had occurred in Switzerland, and doubted if any governor would keep control in the circumstances. The governor may act like a charm for years at a time, taking care of all kinds of lightning and switchgear surges; but one day, for no apparent reason, the machine starts to hunt, sometimes with disastrous results.

"The machines at Sidrapong are now being run successfully without governors. A tachometer has been fitted to each machine, and a machine coolie stands by with his hand on the control wheel and his eye on the tachometer. His whole job for four hours at a stretch is to adjust the control wheel so that the tachometer pointer is always against a red line on the dial. He does this splendidly. An educated man would probably either smash up the machine or go to sleep before the end of the four hours, but the job neither worries nor bores the coolie. I propose to adopt this arrangement for the new plant."

I may add that we are fortunate in having no Trade Union to object to the employment of what may, perhaps, be called the "Coolie automatic voltage regulator," a type which is not described in Mr. C. C. Garrard's recent paper on the subject. The cost of each regulator of this type is Rs. 10, or, say, 13s. 4d. per mensem, and no repairs are necessary—not even a "little bit of string" is required to prevent them being too sensitive.

[* Mr. Robertson's regrettable decease is announced in the following article.—Eds. Elec. Rev.]

INDIAN NOTES.

[FROM OUR SPECIAL CORRESPONDENT.]

Allahabad and Lucknow Electric Lighting Schemes.—"Residents of Lucknow and Allahabad," says the *Pioneer*, "have heard so much of electric schemes that have come to naught, that they might be excused perhaps for feeling somewhat sceptical on the subject of the possibilities of electric lighting for the two capitals. It appears that an important new development in the carrying out of the much canvassed scheme has recently taken place. The licensees, Messrs. Crompton & Co., have been given guarantees by the two municipalities concerned of 4½ per cent. per annum on the paid-up capital required—a sum amounting to 15½ lacs of rupees (£100,000). The arrangement arrived at is that the municipalities are to share all the profits above the 4½ per cent. guaranteed for the seven years' period of their guarantee—the licensees anticipating that the concerns will pay at least 8 per cent. after three years' working. If this anticipation is realised the municipalities should do well on the deal. It is proposed to form a limited liability company, under the Indian Companies' Act, with the well-known firm of Messrs. Martin & Co., of Calcutta, as managing agents, the capital to be raised in India, and residents of the two towns being given an opportunity of taking shares in what is expected to prove a profitable investment.

"It is also, it may be mentioned, anticipated that when the supply of electric power is available, an additional demand is more than likely to arise in the way of small industries, which are wont to spring up where electric power is obtainable. The ideas of the promoters of the present scheme are, we understand, not confined to meeting the wants of the wealthier classes only; arrangements are to be made to install lamps in bazaar shops, the tenants to be charged a flat rate of a few annas per lamp per month."

The above has been taken from a recent article in the Allahabad *Pioneer*, and it gives some idea as to how matters stand regarding the proposed supply of electricity for lighting and power for the two cities mentioned. With regard to Lucknow, the residents may well indeed be sceptical, as there have been at least half a dozen schemes drawn up and discussed within as many years. The authorities, both civil and military, must have sheaves of estimates pigeon-holed somewhere appertaining to an electric supply: and, incidentally, the hotel-keepers of Lucknow must be a good deal in pocket, through the sums spent by the representatives of various contractors in Calcutta and Bombay who have been periodically invited, or, rather, seduced to Lucknow to draw up estimates, which, being sent to the authorities concerned, after much trouble and great expense, were not even acknowledged—a want of courtesy which, by the way, is characteristic of Indian methods.

It is reported that a wealthy Indian has promised to subscribe 7½ lacs (£50 000) for the Lucknow scheme if the municipality consent to give his name to the undertaking.

Calcutta Electric Supply Corporation, Ltd.—The consulting engineers of this prosperous company in London have recently given a contract to the British Thomson-Houston Co., of Rugby, for a 6,000-kw. set—the largest steam turbine set out East—for the new Cossipore power house, Calcutta.

The present plant consists of four 3 000-kw. Oerlikon steam turbine sets, one 800-kw. ditto, and four 500-kw. Belliss sets; the supply is at 6,000 volts, 50 periods, transformed at several sub-stations to 450 volts direct-current three-wire, and covering an area of 109 square miles.

Darjeeling.—The death is reported through drowning of the popular and very able municipal electrical engineer, Mr.

G. P. Robertson. He recently spent a period at home and on the Continent, inquiring into the most recent and modern improvements in long-distance hydro-electric transmission practice, and on his return to India was deputed to survey and develop a further scheme for the Darjeeling extension electric power system. It was while actively engaged in this operation that he recently met his end by his boat being capsized in the Rungeet River. He was an extremely able and energetic engineer, and a hard-headed Scotsman, whose advice and guidance will be sadly missed by the Darjeeling municipality. Besides being electrical engineer, he was in charge of the sanitary, drainage and buildings department of this flourishing municipality, and his work in each of the departments attest to his all-round capabilities.

CONDITIONS AFFECTING THE VARIATIONS IN STRENGTH OF WIRELESS SIGNALS.

The paper read before the Institution of Electrical Engineers by Prof. E. W. Marchant, and abstracted in our last issue, was discussed in London on February 11th.

Mr. W. Duddell, in opening the discussion, said the paper raised many questions, but he would confine himself to the problem of measurements, because insufficient results had been obtained to enable satisfactory conclusions to be arrived at as to the discrepancy between day and night signals. He referred to the necessity for organised observation over a wide area, pointing out that the programme discussed in Brussels for making such measurements, which had been abandoned owing to the war, showed the difficulty of keeping constant conditions of measurements in different places. He took issue with the author as to whether the Einthoven galvanometer was so sensitive as stated. Lately Abrahams had constructed an improved moving coil galvanometer in Paris, which was quite as sensitive as the Einthoven instrument, and it was evident that we were on the point of obtaining a sufficiently sensitive instrument to record long-distance measurements.

Mr. Vyvyan, who apologised for the absence of Mr. Marconi, mentioned that some long-distance records of night signalling had been obtained from Melbourne, ship to shore and *vice versâ*, covering 2,000 miles with a 1½-kw. set, which was the greatest distance obtained with such a set. It was difficult to come to any conclusions as to conditions, &c., without some organised system of collaboration, extending over a period, for making observations.

Dr. W. H. Eccles thought the most useful feature of the paper would be the details of the use of the Einthoven galvanometer, especially when organised measurements could be made. In the Pacific it was found that with a 2-kw. wireless set it was normally possible to communicate over 2,000 miles at night, and freak signalling in the summer had been established over 3,000 miles and 3,500 miles in the winter. In the day the possible range was only some 200 miles. Dr. Marchant was only getting one-tenth of the variation that was being obtained in Pacific work. For short distances the upper layers of the atmosphere probably had little influence on the result, but it was otherwise in long distances. In wet weather, the loss of insulation increased the damping effect, and might account for 20 to 30 per cent. difference in measurements.

Mr. J. E. Taylor said as regarded the theoretical assumptions as to causes of varying strength of wireless signals, he had little belief in any of the speculative theories put forward, particularly in regard to ionised air, &c. He suggested that the antenna had superimposed on its own field another field due to the atmospheric potential grade, which had the effect of greatly increasing the field in an upward direction, and this gave rise to radiation at a high level much above the normal. As the range increased defraction due to low level radiation would sift out, but the high level radiation would persist.

Admiral Sir H. B. Jackson thought the Pacific would be an excellent area in which to experiment on account of its numerous small islands and long-distance transmission.

Mr. Campbell Swinton expressed surprise at the uniform results said to have been obtained with the crystal detector, which was usually very variable. No other method of measurement was so sensitive as the galvanometer method, and it would be a great benefit if a method could be devised which eliminated rectifying the current.

Dr. J. A. Fleming, whose remarks were communicated, said that similar measurements had been carried out at University College on signals coming from the Eiffel Tower. The signals were received on an Einthoven galvanometer through the usual form of tuner. To calibrate the galvanometer they used two coils, the mutual inductance of which at various distances was known, so that by measuring the primary current by hot wire ammeter they could determine the value of the secondary current; the latter was made to take the place of the antenna current, and it was then possible to repeat the deflections of the Einthoven galvanometer produced by the Paris signals by a known current in an artificial antenna using the same frequency. The observations were made by Mr. Coursey; from the charts made it appeared that the greatest falling off in signal strength occurred when it was clouded both in Paris and London. But before any valid conclusions could be drawn it would be necessary to have an antenna set up near Paris and an automatic record kept of signal strength close to the sending station; such an antenna should be in duplicate—earthed and non-earthed. He could not believe that the large variations of strength in only 200 miles observed in London were entirely due to ionisation of the air; in short-distance transmission there was a considerable degree of propagation through and over the earth's crust, and reception was not entirely due to a true space wave.

Prof. Howe said he also had been making measurements of signals, &c., with a view to getting measurements of the actual field set up by the signals. He explained the difficulties of thermal galvanometer measurements, admitting the advantages of the Einthoven galvanometer method used by the author, which eliminated trouble due to other people sending signals. Basillie had showed that if the wave length was altered only a very little, great differences in results were obtained. He was very glad to hear a denunciation of the ionised atmosphere theory; it could be made to fit any desired condition at will.

Prof. Marchant, in replying, said he wished to stimulate observation of signals, and had put up theories with a view to their being demolished if necessary. It was extremely difficult to calibrate an aerial, and they were driven to calibrating the secondary. The Einthoven galvanometer was one of the best available. He agreed that the Pacific was a wonderful place for transmission, and that this result was due to local conditions, as such results had never been obtained anywhere else. The energy record was quite different from the distance record. He found it quite hopeless to try to take direct measurements of signals. The ionised air theory was excessively convenient as a medium of explanation, but he was bound to say he thought ionised air was a factor.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Electric Heating and Ventilation.

The Credenda Conduits Co., Ltd., of Chester Street, Aston, Birmingham, after having spent a considerable time in experimenting and tests, have just placed on the market a system of heating and ventilating by electricity, and have now actually at work at the showrooms of their London agents (Messrs. Baxter and Counter, Ltd., 219, Tottenham Court Road), an installation giving very satisfactory results in an exceedingly difficult situation, which they invite anyone interested to call and inspect.

Some of the advantages claimed for this system are set out below:—

It ensures proper circulation, distribution and equalisation of temperature, which is essential to a proper heating system.

Immediate results are obtained as soon as the electric current is switched on, in all parts of the building, and the heat is not localised as is the case when separate radiators or fires are used.

The system is entirely automatic in its action and requires no attendant.

It requires no coal or water, as in the case of steam heating plant, and does away with all boilers, radiators, steam pipes, valves, traps and pumps.

It can be used for cooling the atmosphere in hot weather, and can be fitted with air filters and ozonisers, which makes it an ideal system for hospitals.

The system is considerably less expensive both to install and maintain than steam heating and other systems.

The system is so arranged that by switching on the full load the desired temperature of about 60° F. is obtained during the first hour, and the consumption of current can then be reduced to about a third, which would maintain this temperature.

The company are prepared to undertake the installation of their system in any building, and to advise and quote for any work. They also make up these plants in a portable form, which can be easily carried from room to room. They will be pleased to give full particulars as to the capacity and output of their various plants, with the cost of running per hour, to those interested.

An Electric Kitchen in Derby.

The accompanying illustration shows the electric kitchen of the Whitehall Café, St. James's Street, Derby, which has recently been equipped under the direction of Mr. T. H. Thorpe, Derby, the architect for this imposing building and the Kinema Hall adjoining the Café.

The electrical equipment, which was all supplied by the British Electric Transformer Co., Ltd., London, at present comprises 34 standard "Tricity" hot-plates, all of which are operated from indicating control panels, with separate "on and off" switch and fuse, the hot-plates being interchangeable; 18 are for boiling purposes, and the remainder for operating two double ovens and four single ovens. There are, in addition, two 24 in. × 12 in. 6-kw. radiant grills, and a carving table 5 ft. × 2 ft. 3 in. × 2 ft. 10 in. high with hot cupboard, and two carving dishes with a maximum loading of 7 kw.

The general arrangement was set out by Mr. F. S. Grogan, of the British Electric Transformer Co., Ltd., in conjunction with the manageress of the Café, Mrs. A. Etheridge.

In the view at the far end will be noticed the meat grill, and on the table on the left are shown 12 boiling plates together with two single ovens opposite the chef's table. On the adjoining table two double ovens and two single ovens are grouped, for the use of the patissier who makes the whole of the cakes, rolls and pastries for the restaurant, and also for the shop attached to the Café. At the far end of the kitchen on the right are the washing-up sinks.

The second grill, which adjoins the ovens, is retained for toasting work. On the opposite side of the kitchen are four hotplates, with water urns, and water-jacketed coffee and milk urns, these being immediately behind the tea dispatch counter. The carving table, which is in the centre of the kitchen, was installed here temporarily, but has since been removed to the restaurant.

The Electric Kitchen of the Whitehall Cafe, Derby, Equipped with "Tricity" Apparatus.

The electrical arrangements have worked so satisfactorily that extensions are at the moment in hand for the equipment of the basement floor with four additional ovens and two more grills. It is hoped that this will be opened during the next week or two.

The business of the Café has during its first two months' working far exceeded expectations, and this result is undoubtedly due in a large degree to the appointment of Mrs. Etheridge, who has not only had West End experience, but was for a time associated with the "Tricity" House, London.

The Café is illuminated by indirect lighting, and its cosiness makes it an attractive rendezvous. The supply pressure is 230 volts, and the installation is balanced on the two sides of the three-wire system. There is also a duplicate service carried into the meter room, with a three-pole throw-over switch.

WAR ITEMS.

Board of Trade Reports.—The Board of Trade Commercial Intelligence Department has now issued list (8 B), which is the weekly list dated February 13th, of inquiries for sources of supply of goods. Copies may be obtained by British manufacturers on application.

Metal Prices in Germany.—According to *La Lumière Electrique*, the price of copper in Germany is about £110 per ton; of aluminium, £225 to £250 per ton, compared with £80 before the war; and of antimony £100 to £105, compared with £22 10s.

York Electricity Employés.—A return made by Mr. J. W. Hame, electrical engineer and tramway manager at York, shows that 55 of the staff are serving with the Colours—22 from the electricity department and 33 from the tramways department. Two men formerly in the latter have lost their lives—H. Rawson, of the King's Own Scottish Borderers, and G. Britton, of the Lancs. Fusiliers.

"Khaki."—We have received a copy of the first number of a 6d. monthly magazine—*Khaki*—which, together with a called news sheet, has been published for the purpose of keeping the over-sea soldier posted with news from the Colonial home that he has left behind him the while he lends his aid to the Mother Country. The magazine is a very creditable production, containing a number of attractive features; the illustrations, some of which are executed in colour, are a strong point. Among the contributors to this number are Marie Corelli, the Earl of Ronaldshay, Lord Willoughby de Broke, Israel Zangwill, Rudyard Kipling, Jerome K. Jerome, Norman Bentley, W. T. A. Beare and Victor Grayson. The magazine *Khaki* is published at Imperial House, Kingsway, W.C., and is stated to be a patriotic—not a commercial—enterprise.

Notes from France.—M. H. Parodi, who bore a prominent part in the proceedings of the joint meeting of the Société Internationale des Electriciens and the Institution of Electrical Engineers at Paris in 1913, as chief engineer of the electric service of the Cie. des Chemins de fer d'Orléans, went to the front as lieutenant of artillery. *La Lumière Electrique* announces that in consequence of his eagerness to undertake any dangerous task that offers itself, and his excellent work in the trenches, he has been named Chevalier of the Legion of Honour and promoted to captain. His high position on the railways would have entitled him to higher rank than that of lieutenant had he chosen to accept it. M. J. L. Routin has also received the Order.

Amongst those who have fallen are P. Le Bœuf, a valued contributor to *La Lumière Electrique*; Henri Bureau, of the Laboratoire Central d'Electricité; and Paul Reuss, chief engineer to the Compagnie Thomson-Houston.

The same journal gives a complete and detailed list of the enemy firms of an electrical character that have been sequestrated by the French Government.

Russian and British Relations.—A Reuter dispatch from Petrograd states that at a distinguished gathering of professors held there, which was attended by Councillors of the Empire and members of the Duma, M. Bieloff, librarian to the Duma, delivered a lecture in which he urged that a society should be founded for establishing closer relations between Russian and British professors and students. An influential Committee was appointed, and the desire was generally expressed for the eradication of German influence from Russian education.

German Electric Concern Sequestrated in Kieff.—The *Kieff Mysal* says that by decree of the War Department the Kieff branch of the German concern called the Siemens & Halske Russian Electro-Technical Factories Co. has been sequestrated. The property of the branch referred to is valued at several hundred thousand roubles.

Relief Fund.—Messrs. Raphael Tuck & Sons, Ltd., have issued their patriotic subject "Defenders of the Empire," in popular postcard form, in the form of an "Oilette" picture for framing, and as a zag-zaw puzzle. The entire proceeds are to go to the Prince of Wales's National Relief Fund

The Government and Engineering Labour. — As a result of the recent conference between the Engineering Employers' Federation and the Engineering Trade Unions to secure greater output required by the Admiralty and War Office, the Executive Council of the Amalgamated Society of Engineers has issued a statement to its members setting forth the proposals and suggestions of the Unions to overcome the shortage in various classes of workpeople. They are as follow :—

(*a*) Firms not engaged in manufacture of war goods to be given such work.

(*b*) Firms at present working short time to transfer their workmen to firms engaged on Government work.

(*c*) Joint representations to be made to the Government to pay subsistence allowance to men working in places a distance from their homes.

(*d*) That the Government draft skilled engineers from Australasia, Canada, and South Africa.

(*e*) In view of the fact that 10,000 skilled engineers have recently enlisted, thus reducing the supply of skilled labour, the Government should withdraw from military duties all those available for industrial purposes.

The men's representatives consider that if the foregoing suggestions were adopted, a sufficient supply of skilled labour would be at the service of the nation to cope with the national situation without encroaching upon the trade rights of operative engineers. We should have thought, however, that the present is not the time to insist upon "trade rights." There has never been a time in the history of Trade Unionism when there was more need for the co-operation of employer and employé. Apparently patriotism and Trade Unionism are not convertible terms.—*Machinery Market.*

A War Trade Department.—According to a statement published in several newspapers, in view of the complexity and volume of work involved in dealing with applications for export and import licences during the war, a Department under the Treasury (to be called the War Trade Department) has been formed to replace the Committee on Trade with the Enemy, so far as this work is concerned. At the request of the Prime Minister, Lord Emmott has consented to act as Director of this Department, and Sir Nathaniel Highmore will be the secretary. The War Trade Department will deal with all applications for the grant of export and import licences, and will embrace an intelligence division, which will serve as a clearing house for all war commercial information. The remainder of the work of the Trading with the Enemy Committee (relating to the movements of funds and other questions in which the Treasury is mainly concerned) will be transferred to the Treasury, and will be performed by Sir Arthur Taring, the Parliamentary Counsel, and his staff. Exporters and others concerned are informed that all applications for licences to export prohibited and restricted goods, and all communications in respect thereof, which have hitherto been sent to the Commissioners of Customs and Excise, should be sent to the offices of the new Department, addressed to the Secretary, War Trade Department, 4, Central Buildings, Westminster, S.W.

Incandescent Electric Lamps in Russia.—At a recent meeting of the electrical section of the Russian Technical Society, it was shown that the number of electric incandescent lamps in use in Russia is about 15,000,000, and that the increase in the use of electric light is about 15 per cent. per annum. It was calculated that the annual demand for lamps would be, 10,000,000—7,500,000 renewals, and 2,500,000 to supply increased demand; lamp sockets, 3,500,000; switches, 2,000,000; plugs, about 1,000,000; and knife switches, about 10,000,000. On the question of the possibility of producing these goods in Russia no clear views were expressed. The meeting thought the estimated quantities were very moderate, and that the number of 10,000,000 as the annual consumption of lamps might be accepted in all safety.

Dublin Electricity Staff —In a report issued by the Dublin Electricity Committee, authority is asked for to pay extra remuneration on a re-arrangement of the engineering staff owing to four of its members—Messrs. Donnev, Carrigg, Clancy and Cox—volunteering for Army Service. It having been decided to push forward the conversion of the gas lamps to electric, Mr. E. J. Davidson has been put in charge of the construction work. The total salaries of the four engineers referred to amount to £543; the allowance of half-pay to relatives is stated at £281, and the special allowance required for the war period is £191.

War Bonus.—The directors of the British Insulated and Helsby Cables, Ltd., Helsby, have decided, owing to the increased cost of living, to grant war bonuses as follows:—To workers receiving 30s. per week or over, a bonus of 3s. per week; over 20s. and less than 30s., 2s. per week; under 20s., 1s. per week. The bonuses, which started as from Thursday last week, and apply to male and female workers, will run for three months, and it will then be considered whether they shall be continued or modified or withdrawn.

Anglo-Belgian Co.—We observe that a new company known as the Société Anglo-Belge D'Exportation, Ltd., has been registered with a capital of £5,000 in £1 shares, to carry on the business of merchants, electrical, mechanical and building contractors, &c. Among the first directors are Mr. R. W. Blackwell and Mr. Philip Dawson. The offices are at 14, Great Smith Street, Westminster, S.W.

Learning Russian.—In reply to a question in Parliament the other day it was stated that the Board of Education were considering with the Board of Trade, possible extension of the teaching of Russian in commercial schools and classes and other educational institutions. It is stated that the City of London College, Moorfields, has some 60 students learning the language.

Blackpool Employés.—There are now some 64 members of the Blackpool Corporation electricity and tramways department serving H.M. Forces in different units.

"To What Base Uses."—*Eastern Engineering* says that the Allgemeine Elektricitäts Gesellschaft "no longer manufacture 10,000-KW. turbo-generators. They are making brass buttons instead."

Personal.—Sergt. J. Stephenson, of the 2nd South Lancashire Regiment, who had been mentioned in Sir John French's dispatches, was formerly employed in the Nelson tramways department.

London Gazette notice: Territorial Force.—Cornwall (Fortress) Engineers, Electric Lights Company, Sergt. Bernard Harvey Peter to be Second Lieutenant, February 24th, 1915.

The *Times* states that King Albert of Belgium and Admiral of the Fleet Lord Fisher were elected honorary members of the Institution of Civil Engineers on Tuesday last.

Roll of Honour.—Lance-corpl. J. Alfred Donald, of Blackpool, formerly an employé of the Blackpool Corporation electricity department, died suddenly last week while on leave, the cause being cardiac trouble. He was 24 years of age, and had recently joined the Royal Naval Division Engineers stationed at Deal.

We have received from the British Aluminium Co., Ltd., a copy of the "Roll of Honour" prepared by the company, giving the names of the very large number of representatives from the different offices and factories who have joined the Army and Navy. It takes the form of a large wall sheet.

LEGAL.

Swansea Gas Light Co. *v.* Swansea Rural District Council.

The hearing of this case was concluded in the Court of Appeal, composed of the Master of the Rolls, Lord Justice Phillimore, and Mr. Justice Joyce, on Tuesday last week, upon the plaintiffs' appeal from a judgment of Mr. Justice Warrington.

Plaintiffs brought the action for a declaration that an agreement made between the parties dated November 5th, 1909, was still in force and valid. Plaintiffs were supplying gas in Swansea and district under statutory authority, and by the agreement the company agreed to extend gas mains to certain roads in Llansamlet and Clase Rural, and to supply gas to public lamps of the defendants upon certain terms, and during the continuance of the agreement defendants covenanted not to put in force the powers conferred upon them by the Llansamlet Electric Lighting Order (1908) for the supply of electrical energy for street or private lighting within that portion of their district agreed to be lighted with gas under the agreement, and that they would not during the period substitute any other method of lighting for gas supplied by the company; but nothing in the agreement should prevent the defendants at any time putting in force the order for the supply of power. The agreement was to run for 25 years. Some of the roads referred to in the agreement were outside the area within which the plaintiffs had power to supply, and by the Swansea Gas Order (1910) the limits were extended; the price of gas within one mile of Swansea was the same as that charged within the borough, and the gas mains were to be extended, &c. Relying upon that agreement the plaintiffs had incurred considerable expense in laying mains and running service pipes from the mains to the lamps for public lighting. Defendants contended that the effect of the order of 1910 was to supersede the agreement and to release them from liability thereunder, and they claimed that they were now at liberty to put in force their power of supplying electrical energy for lighting within any portion of the district agreed to be lighted with gas by the plaintiffs, and they had begun to lay cables for the supply of electricity in districts served with gas by the plaintiffs. Defendants also pleaded that the agreement was *ultra vires* and denied committing any breach of it, and they also relied on the provisions of the Public Authorities Protection Act, 1893. Mr. Justice Warrington held from what took place in the House of Lords' Committee Room in 1910 it was agreed that the agreement should be superseded, and he, therefore, gave judgment for the defendants with costs, and from this decision the plaintiff company now appealed.

Mr. George Cave, K.C., M.P., and Mr. Percy Wheeler appeared in support of the appeal; and Mr. Clauson, K.C., and Mr. Tomlin, K.C. for the respondents.

Mr. Cave contended that when the agreement was come to in 1909 it was contemplated by everybody that the plaintiffs should apply for a provisional order to extend their area of supply. At the trial the Council's witnesses said it was expressly agreed in the Committee corridors that the agreement should be rescinded, but that the Gas Co.'s witnesses denied, and the learned Judge had held that the question of rescission was not raised. Unfortunately, when the Committee was finally informed of the settlement, the company's agent, Mr. Cooper, used the following words:—"Would your Lordship allow me to mention in connection with the new clauses 6 and 6*a*, that they are the result of an agreement come to in reference to the terms of the order, which agreement is a compromise, and supersedes the agreement made between the promoters and the opponents in November last?" On that sentence

the learned Judge had decided that the whole agreement had gone. He (Counsel) contended that the only point discussed between the parties was price.

Mr. Justice Joyce: Of what use is the rest of the agreement to you?

Mr. Cave: It gives us the public lighting of those parishes for 25 years on terms which have been very carefully laid down, and without which it would be impossible for any company to undertake public lighting in any district. He submitted that the appeal ought to be allowed.

Mr. Clauson and Mr. Tomlin having supported the judgment of Mr. Justice Warrington on behalf of the respondents, and Mr. Cave having replied at the conclusion of the arguments, the Master of the Rolls, in delivering judgment, said that for the defendants to succeed they had to establish that the agreement in question had been superseded by an agreement made in the House of Lords when the company were obtaining their provisional order. To succeed the defendants had to establish that there was a contract to that effect. Mr. Justice Warrington had come to the conclusion that there was no such bargain, and it was impossible for the Court to take a different view. But the Judge had held that although there was no binding agreement made in 1910 for the supersession of the document of November, 1909, yet the parties had proceeded on the footing that there was some such agreement. That was a proposition on which there had been no real argument, and it was not necessary to decide it. But Mr. Justice Warrington had held that the application for a provisional order extending the Gas Co.'s limits of supply was in the minds of both parties in November, 1909, and under these circumstances it was not open to the defendants to say that the contract could not be enforced.

The other Judges concurred, and the appeal was accordingly allowed, and a declaration made that the agreement of 1909 had not been cancelled by any such agreement as was suggested, nor was it varied save (if at all) so far as it was varied by the provisional order.

The appellants were awarded the costs of the appeal, there being no order as to the costs in the Court below.

L.C.C. *v.* Assessment Committee of the Borough of Islington.

In the House of Lords on Monday the hearing was concluded of an appeal by the L.C.C. against a decision of the Appeal Court, which set aside an order of Mr. Justice Bray and Mr. Justice Lush for the appointment of a person to make a provisional valuation list containing the gross and rateable value of the tramways as reduced. The Council made its application for a valuer on the ground that competition by motor-'buses had affected the tramways and entitled them to a provisional assessment. Their Lordships now allowed the appeal, and stated that they would give the reasons for their decision at a later date.

Fosbery *v.* Dublin United Tramway Co., Ltd.

On February 19th, a Dublin jury awarded £1,100 to Mrs. Fosbery, wife of Mr. George Fosbery, an official of the National Bank, Dublin, who sued the Dublin United Tramway Co. for damages for injuries caused to the plaintiff by defendants not having properly lighted a lorry in Dublin one night last December, whereby the plaintiff fell over the shafts of the vehicle. Defendants accepted the verdict, but contended that the damages were excessive. A stay of execution was granted to enable them to move further in the matter, and they agreed in the meantime to pay £200 to the plaintiff.

DISTRIBUTION AND RISE OF TEMPERATURE IN FIELD COILS.

By Prof. M. MACLEAN, D.Sc., M.I.E.E., D. J. MACKELLAR B.Sc., A.M.I.E.E., and R. S. BEGG, Grad.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Glasgow, February 9th*, 1915.)

The paper deals with the temperature rise at various points in a field coil of a 120-kw. variable-speed d.c. motor, under various conditions; the motor is installed in the Royal Technical College, Glasgow, driving an alternator, and is a six-pole 500-volt machine with commutating poles and a compensating winding. Thermo-couples of copper-constantan were provided by the makers in one of the coils, as shown in fig. 1; the rise of temperature of E was practically equal to that of A, and D to B, so D and E were omitted from the curves. The distribution of temperature is shown in fig. 2, for an armature current of 8 amperes, and fig. 3 shows the rise of temperature at the hottest point C for the same armature current, while fig. 4 shows the rise for an armature current of 150 amperes.

The field coil is cylindrical, with a superficial area of 1,746 cm^2., excluding the area of the pole shoe, which is 1,450 cm^2.

The ratio of the final rise of temperature to the number of watts is greater for the higher speeds as shown in Table I. A speed of 750 r.p.m. corresponds to a peripheral speed of the armature of 23·56 metres per second. On the other hand, the ratio for generators is less for increasing speeds.

TABLE I.

Field current, amperes.	Armature current, amperes.	Peripheral speed, m. per sec.	Final rise of temperature at C in degrees C.	Watts.	Rise in temperature ÷ watts after 6 hours.
1·2	8	23·56	9·4	28·82	0·326
1·65	8	17·9	11·4	55·14	0·207
3·5	8	12·25	51·2	295·8	0·173

Hawkins and Wallis give the following expression for the field coils of dynamos:—

$$\text{Rise of temperature} = \frac{\text{watts}}{\text{area}} \times \frac{a}{1 + b\,v},$$

where a and b are constants.

If this equation is applied to the results in the above table at a load of 8 amperes in the armature, and is solved for the three

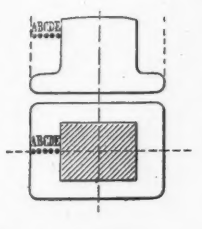


Fig. 1.—Position of Thermoc-ouples.

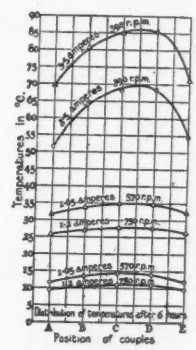

3·5 amperes 390 r.p.m.
1·65 amperes 390 r.p.m.
1·65 amperes 570 r.p.m.
1·2 amperes 750 r.p.m.
1·65 amperes 570 r.p.m.
1·2 amperes 750 r.p.m.
Temperatures in °C.
Distribution of temperature after 6 hours
A B C D E
Position of couples

Fig. 2.—Distribution of Temperature.

speeds, the three simultaneous equations give three results, the mean of which gives $a = 198\,6$ and $b = -0{\cdot}0263$. Substituting these values of a and b, the results set out in Table II are obtained.

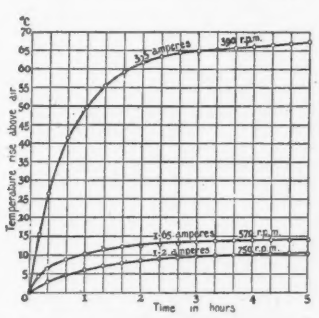


Fig. 3.—Temperature Rise of Couple C.; Armature Current 8 Amperes.

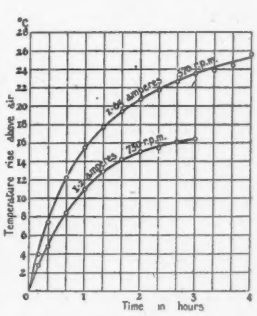


Fig. 4.—Temperature Rise of Couple C; Armature Current 150 Amperes.

The results obtained by dealing similarly with the rises of temperature in four hours, and with a current of 50 amperes in

TABLE II.

Peripheral speed of armature in metres per second.	$\frac{198\,6}{1 - 0{\cdot}0263\,v.}$
23·56	524
17·9	376
12·25	293

the armature are 512, 414 and 325 respectively, the mean values of a and b being 232·8 and $-0{\cdot}023$ respectively.

Electric-Light Switching Examinations.—We have on previous occasions alluded to the examinations instituted by Messrs. A. P. Lundberg & Sons, and the subject is brought to the front once more by the lists of successful competitors in the most recent of these examinations, which are published in this issue. Considering that the subject dealt with mainly concerns those of fighting age, the results given are eminently satisfactory so far as numbers go, and it is to be presumed that they are also satisfactory from the examiners' point of view. It seems that the subject of electric-light switching (otherwise, the control of glow-lamp circuits by means of more or less special tumbler switches), which has been brought into prominence by this means, has come to stay.

REVIEW.

Brown's Marine Electrician for Sea-Going Engineers. By A. E. and A. H. Larkman. Glasgow: J. Brown & Sons. Price 5/- net.

Since we last reviewed this book, in our issue of December 1st, 1905, it has been very considerably revised, and many of the criticisms we then made have apparently borne fruit. There is, however, still a need for the elimination of those parts which appertain only to land installations, whilst more space might be suitably devoted to "wiring," which is somewhat inadequately treated in the present edition as regards its special bearing on ship work.

It is news to us to learn that commutators are now made of phosphor-bronze instead of copper. We think the authors must be generalising from some particular instance they have in mind.

In discussing alternating current, the authors appear to be under the impression that high pressures are essential. On page 23, in discussing alternating currents generally, the reader is given the impression that the usual method of dealing with alternating current is to generate at 5,000 volts and transform in the station down to 2,000, and then transmit the current at this pressure to the point of consumption, where it is again transformed to about 50 volts. We learn also that "alternating currents have been used and discarded intermittently by engineers, but since the introduction of transformers their use aboard large vessels is probable," notwithstanding that, according to the authors, "the distribution of current to several points of consumption introduces difficulties where A.C. is used." All this is quite irrelevant to marine practice, as the question of high pressures does not arise.

There is a little inconsistency here and there, as, for example, in connection with single wiring. On page 3 the authors state "C.C. (continuous current) is very suited to the single wire system of distribution so much used in ship lighting," whereas on page 144 we learn that "single wiring is abolished in the Royal Navy, and is also disappearing in the newer types of mercantile marine." As a matter of fact, we believe that the single wiring system has been practically obsolete for many years.

Dealing with the methods of driving in vogue, the authors are behind the times in referring to belt driving of dynamos on board ship, as the almost invariable practice now is the direct coupled system. Seeing that one of the authors is a marine engineer, we are surprised at the suggestion to place a dynamo two decks vertically above its driving engine, and also that special multiple-cylinder engines such as "Brotherheads," *(sic)* "Williams," *(sic)* "Central Valve," "Tower" and "Globe" are now used for electric lighting on board ship.

The section on wires and cables is fairly well done, and the illustrations of joints are very clear, but we think the Britannia joint is hardly applicable to ship lighting work, as the only use to which it is put is in connection with overhead bare solid conductors. In this section there are one or two misprints in connection with the diagrams. The jointing system shown in fig. 102 is referred to as fig. 103, and the three-contact rose system is referred to as 104 instead of 103. This diagram, and also fig. 104 of the three-contact rose, refer really to land installations where flexible pendants are used from ceiling roses.

The chapter on accumulators contains some useful information, but the authors are weak on the theory of the accumulator, as, according to them, the action of charging coats one plate with a layer of hydrogen bubbles, and the other with a thin layer of lead sulphate, the lead having united with the SO_4 of the acid. On discharging, a current flows in the opposite direction and the plates return once more to their normal condition—"that is the whole theory of accumulators." The illustration, as in the previous edition, shows a group of accumulators in glass boxes, although the authors now rightly add that cells for ships' use are more usually made of lead or teak. The fact is they are almost invariably of lead-lined teak, and we would suggest that if any future edition is called for the illustration should be amended accordingly.

Generally speaking, there is much useful information in the book for marine electricians, but its value is impaired by the insertion of matter which has very little bearing on marine work and by inaccuracies here and there, some of which we have pointed out above.—F.B.

ELECTRIC HEATING AND COOKING.

A paper was read on this subject at a recent meeting of the Birmingham and District Electric Club by Mr. R. Weaving (Manchester). The author said that for the past four years electrical heating and cooking had been serious competitors for older methods to meet, and there was no doubt that the invention of the nickel-chrome resistance alloy had been of the utmost importance in aiding the development of the apparatus. Previous to this discovery there was no common metal which could be safely run at a bright red temperature for any length of time when exposed to the air; consequently the most popular electric heater, the electric fire, could not have existed without nickel-chrome wire. He regarded the electric fire as the best heater, as it had the following advantages: (1) It warmed immediately by means of radiant heat, any solid body placed before it; (2) it warmed the air gradually, but much more quickly and directly than a lamp radiator; (3) it had the appearance of a fire. To be a commercial success the electric heater must be reliable, inexpensive to maintain and low in first cost; the terminals should be heavy and placed in a convenient position; the amount of wire used in the element should be as large as possible, and an earthing terminal should be provided. As on most electric heaters the switches were near the ground, a tumbler switch was more convenient than the rotary type, and although the tumbler was more often operated by the foot than the hand, a good switch would stand this treatment quite well. The electric heater to compete commercially must be roughly 19 times as efficient as the coal fire and 3-1/3 times as efficient as the gas fire. These were very great disadvantages, but still they found that electricity could hold its own. With an electric heater no combustion took place and if proper precautions were taken the whole of the heat generated was useful. With a gas or coal fire the products of combustion had to be taken away, and with them went the greater part of the heat. This was fatal to high efficiency. Electricity had many advantages the value of which was hard to express in money. One great advantage was portability; this enabled two or three fires to do duty for a house, whereas the gas fire must be fixed. To this might be added the absence of risk of explosion, or of fire due to spent matches, and smoke on decorations, etc. A rating giving the best results was 1.5 watts per cubic foot; this would give a temperature rise of twelve degrees in one hour, and half this consumption would maintain the temperature.

The chief points to be considered in electric cooking were reliability, low first cost, and low running costs. Reliability was largely a matter of design. All efforts of design from the engineer's point of view were directed to securing the proper conditions for long life in the heating element. For good and economical cooking the heat should be evenly distributed in the oven, yet the elements should be arranged so that the cook could make any portion of the oven hotter than the rest. The size of terminals was even more important than on electric heaters. They should be heavy enough to remove the slightest doubts of their electrical carrying capacity or mechanical strength. The elements should be easily replaced and cheap to renew. The position of the heating elements was important; bottom heating only did not give good browning on the top of pastry; top and bottom heat was better, and when used in an oven which was broad in proportion to its height, was quite good, but when the oven was of ordinary shape, that is in a ratio of height to width of 3/2 the best results were undoubtedly obtained by the use of side elements. The whole of the interior of the oven should be vitreous enamelled including shelf and shelf racks. The loading of the elements should be enough to raise the oven to a cooking temperature in 25 to 30 minutes, and a temperature of 350 degrees should be maintained by 1/3 heat. It was necessary to get direct radiation on to pastry and meat to insure a good colour, and this could only be obtained by running the elements at a temperature giving the correct proportion of radiant and convected heat to suit the oven. Too much radiant heat would brown the outside without cooking the inside, while too low a temperature on the elements would tend to give tough pastry of poor colour. At present the rotary switch was most favoured

by designers, but the author had used tumbler switches with first-class results, and had had a switch of this type rated at ten amps. breaking 25 amps. at 230 volts 20 to 30 times daily for three months. If the best and most economical results were to be obtained a thermometer must be used. After dealing with the various apparatus, he said there was no doubt that electricity at a penny or even 1½d. per unit compared favourably with gas for all oven work, and when energy could be purchased at a penny per unit or under a complete cooking outfit would not cost more to run than the corresponding gas cooker. In addition there was the unchallenged superiority of the results obtained in an electric oven.

TRADE STATISTICS OF THE STRAITS SETTLEMENTS.

The following statements, showing the imports of electrical and other materials into the various Straits Settlement ports in 1913, is taken from the recently-issued official trade statistics. The values for 1912 are added for purposes of comparison, with notes of any increases or decreases.

IMPORTS INTO SINGAPORE.

	1912. Dollars.	1913. Dollars.	Inc. or Dec. Dollars.
Telegraph and telephone materials.—			
From United Kingdom ...	245,000	724,000	+ 479,000
,, Belgium	6,000	37,000	+ 31,000
,, Germany	—	5,000	+ 5,000
,, France	27,000	—	− 27,000
,, Other countries ...	10,000	9,000	− 1,000
Total	288,000	775,000	+ 487,000
Tramway and railway materials.—			
From Belgium	34,000	71,000	+ 37,000
,, Germany	11,000	8,000	− 3,000
,, United Kingdom ...	68,000	99,000	+ 31,000
,, Other countries ...	—	3,000	+ 3,000
Total	113,000	181,000	+ 68,000
Electrical machinery.—			
From United Kingdom ...	210,000	409,000	+ 199,000
,, Germany	39,000	40,000	+ 1,000
,, Italy	17,000	5,000	− 12,000
,, Sweden	—	4,000	+ 4,000
,, Belgium	1,000	1,000	—
,, United States ...	1,000	6,000	+ 5,000
,, Japan	10,000	7,000	− 3,000
,, Other countries ...	19,000*	16,000	− 3,000
Total	297,000	488,000	+ 191,000
Engines, boilers and parts.—			
From United Kingdom ...	220,000	267,000	+ 47,000
,, Germany	2,000	9,000	+ 7,000
,, Netherlands	—	14,000	+ 14,000
,, United States ...	10,000	12,000	+ 2,000
,, Other countries ...	24,000	16,000	− 8,000
Total	256,000	318,000	+ 62,000
Machinery, other (except sewing machines).—			
From United Kingdom ...	649,000	821,000	+ 172,000
,, Australia	8,000	21,000	+ 13,000
,, Belgium	32,000	14,000	− 18,000
,, Germany	48,000	60,000	+ 12,000
,, Holland	10,000	7,000	− 3,000
,, United States ...	79,000	130,000	+ 51,000
,, Other countries ...	87,000	85,000	− 2,000
Total	913,000	1,138,000	+ 225,000
Lamps and lampware.—			
From Belgium	3,000	7,000	+ 4,000
,, Austria	31,000	12,000	− 19,000
,, Germany	186,000	239,000	+ 53,000
,, United Kingdom ...	128,000	126,000	− 2,000
,, United States ...	16,000	28,000	+ 12,000
,, Other countries ...	26,000	31,000	+ 5,000
Total	390,000	443,000	+ 53,000

* Denmark 3,000 dollars.

IMPORTS INTO PENANG.

	1912. Dollars.	1913. Dollars.	Inc. or dec. Dollars.
Electrical machinery.—			
From United Kingdom ...	66,000	91,000	+ 25,000
,, Germany	38,000	41,000	+ 3,000
,, Other countries ...	6,000*	14,000*	+ 8,000
Total	110,000	146,000	+ 36,000
Engines, boilers and parts.—			
From United Kingdom ...	679,000	657,000	− 22,000
,, Germany	33,000	16,000	− 17,000
,, Belgium	12,000	61,000	+ 49,000
,, United States ...	6,000	24,000	+ 18,000
,, Other countries ...	31,000	30,000	− 1,000
Total	761,000	788,000	+ 27,000
Machinery, other (except sewing machines).—			
From United Kingdom ...	36,000	158,000	+ 122,000
,, Belgium	3,000	6,000	+ 3,000
,, Germany	6,000	10,000	+ 4,000
,, Other countries ...	3,000	11,000*	+ 8,000
Total	48,000	185,000	+ 137,000
Lamps and lampware.—			
From Austria	1,000	1,000	—
,, Belgium	4,000	3,000	− 1,000
,, Germany	56,000	65,000	+ 9,000
,, United Kingdom ...	81,000	60,000	− 21,000
,, Other countries ...	7,000	6,000	− 1,000
Total	149,000	135,000	− 14,000
Telegraph and telephone materials.—			
From United Kingdom ...	40,000	14,000	− 26,000
,, Other countries ...	2,000	3,000	+ 1,000
Total	42,000	17,000	− 25,000
Tramway and railway materials.—			
From United Kingdom ...	2,000	4,000	+ 2,000
,, Belgium	10,000	1,000	− 9,000
,, Holland	—	4,000	+ 4,000
Total	12,000	9,000	− 3,000

* Includes United States 2,000 dollars.

IMPORTS INTO MALACCA.

	1912. Dollars.	1913. Dollars.	Inc. or dec. Dollars.
Telegraph and telephone materials.—			
From United Kingdom ...	1,000	20,000	+ 19,000
Engines, boilers and parts.—			
From United Kingdom ...	4,000	1,000	− 3,000
Machinery, other (except sewing machines).—			
From United Kingdom ...	15,000	116,000	+ 101,000
,, Other countries ...	9,000	18,000	+ 9,000
Total	24,000	134,000	+ 110,000

N.B.—Dollar = 2s. 4d.

BUSINESS NOTES.

Consular Notes.—SPAIN.—An interesting description of the operations of the Barcelona Traction, Light and Power Co., and of its offshoot the Ebro Irrigation and Power Co., is contained in the report by the British Consul-General at Barcelona, which has just been issued.

The effect of all this hydro-electric development on the machinery trade of Barcelona has naturally been to discourage the importation of steam engines and boilers, and correspondingly to stimulate that of electrical plant. Oil engines are not imported nor are they likely to be as long as the duty levied on oils is so high. Gas engines are not asked for at present.

As regards Valencia, the British Consul says that every year there is an increased demand in his district for small motor engines, chiefly petrol, for use in working small pumps for irrigating, and although a certain percentage of British makes are seen, the majority of such motors appear to be of Continental manufacture.

Our Vice-Consul at Palma de Mallorca reports that in view of the successful installation of electric light and power plants in Palma, several companies have been formed for this purpose in the most important towns in the interior, viz., Soller, Alaro, Binisalem, Manacor, Santa Margarita, Inca, &c. It is also hoped to establish a tramway system.

CHINA.—A report has just been issued by H.M. Commercial Attaché at Peking dealing with the foreign trade of China for the year 1913. There is much in this report, despite its lateness, which is still of interest. The vast potentiality of the market is shown by the figures giving the gross value of the foreign trade coming under the cognisance of the Chinese Maritime Customs, viz., £152,000,000 in 1913 (as compared with £132,500,000 in 1912), and by those giving the net value of foreign imports, viz., £86,000,000, being nearly £14,000,000 more than in 1912. The increase in imports is due to a growth of trade all round, and cannot be entirely accounted for by any fortuitous or impermanent circumstances, such as the piling up of import stocks, or a boom in any

particular product. Metals and minerals account for an increase of £1,500,000, and machinery for an increase of £300,000. In connection with these imports there is no indication of the increases being due to over-trading, and from the point of view of those interested in the general trade of China, the figures may be regarded with satisfaction, as compensating to some extent the depression in other branches.

The total entries under the two heads, "Machine Tools and Machinery" (including cotton gins, which appear separately in the Customs returns) amounted in 1913 to a value of £1,087,862, being an increase of £382,863 over the corresponding figures for 1912. The increase is distributed under every item, and especially under the head of "Machinery, Unclassified," which forms nearly three-fourths of the whole; but the increase in textile machinery may be specially noted in connection with the growth of the cotton spinning industry of Shanghai. Hand tools, which are not included in the above figures, rose in value from £30,696 to £41,337. A good deal has been written about the rising demand for hand tools in the China market, and it may be worth while to point out that, great as the demand for such articles may be in the future, the trade in them is at present confined, as these figures show, to very small dimensions. Electrical materials and fittings rose in value from £256,419 to £350,770. The steady increase shown by the figures for this item during several years past is to be attributed to the growing use of electric lighting, which continues to spread in Chinese cities, in spite of financial difficulties. Two or three new installations in minor towns were carried out during 1913, mostly with plant of British manufacture.

The continued rise in the volume of the principal articles of export, and the continually extending variety of articles of native produce, are the most promising features of the foreign trade of China during the last decade, inasmuch as hopes of future development rest primarily on the increase of exports. The percentage of exports to imports went down to 70·7 per cent. in 1913 after an average of 80·3 per cent. in the four preceding years. The export trade had to suffer from high exchange, low prices in the European markets, and especially from the want of silver to finance it. With all these adverse circumstances the Commercial Attaché considers it wonderful that the disproportion between exports and imports in a year characterised by so enormous an increase in the latter, was not much greater than it turned out to be. The situation was, in fact, saved by the fortunate circumstance that the country on the whole enjoyed good harvests in 1913 as it did in 1912.

The following table shows the shares taken by the United Kingdom, Hong-Kong, Japan, and Germany in the import and export trade of China in 1912 and 1913. Two-thirds of the imports, *viâ* Hong-Kong, may be credited to the United Kingdom. Japan is included because the growth of its trade is enormously greater than that of any other country, and Germany, for the reason that German competition has followed perhaps more closely than that of other European countries the lines of British trade. The heading "other countries" includes the trade of India and of the other British Dominions. The figures are approximately in 1,000,000 Haikuan taels (reckoned at 3s. 0⅝d. in 1912 and 3s. 0½d. in 1913):—

	Imports.		Exports.	
	1912.	1913.	1912.	1913.
United Kingdom ...	75	97	16	16
Hong-Kong	148	172	103	117
Japan	88	119	55	66
Germany	21	28	14	17
Other countries... ...	151	170	132	188

The percentage of the trade of the United Kingdom and Hong Kong together to the total foreign trade, has fallen from 48 per cent. in 1905 to nearly 41 per cent. in 1913, that of Japan has risen from 14 per cent. to nearly 19 per cent., that of Germany has risen from 3 per cent. to over 4 per cent., and that of other countries has risen from 35 to 36 per cent.; 40 years ago the United Kingdom and Hong-Kong together accounted for 67 per cent. of the trade, and as trade expands this proportion tends to diminish still further. So long as the trade between the United Kingdom (and Hong-Kong) and China continues to increase in itself, it cannot be said to be in an unhealthy condition. A consideration of the relative growth of the trade of other nations is, however, a useful reminder that the days of unchallenged supremacy are over, and that in order to retain that supremacy a much closer attention to the requirements of the China trade and to the means of supplying these requirements than has been considered necessary in the past is increasingly called for.

Liquidations.—The Lighthouse Radiator Co., Ltd.—Particulars of claims must be sent by March 6th to the liquidator, Mr. J. B. Rapkins, 10, Wellington Place, Guildford. A meeting will be held on March 23rd to hear an account of the winding up.

Ebro Light and Power Construction Co., Ltd.—A meeting will be held on March 22nd, at 232, Strand, W.C. to hear an account of the winding up from the liquidator, Mr. R. H. Bentley.

Stolz Electrophone Co. (London), Ltd. — A meeting will be held at 48, Frederick's Place, Old Jewry, E.C., on March 24th, to hear an account of the winding up from the liquidator, Mr. A. F. Whinney.

Anchor Hospital and Distress Fund.—The fourth annual general meeting of members of this fund, which is in operation at the Anchor Cable Works, Leigh, was held on February 16th, Mr. J. Bowyer (the works manager) presiding. The fund exists for the purpose of making annual grants to hospitals, convalescent homes, &c., thereby ensuring to members hospital treatment in case of accident or other sickness, and for granting temporary relief to members in exceptionally distressed circumstances, so that shop collections may be discontinued. The Hon. Secretary (Mr. A. Crooke) reported that all the employés in the works and offices at Leigh, aged 17 or over, were members, each member paying 1d. per week. He pointed out the useful work which had been done by the fund. Members have been sent to convalescent homes, and recommendations issued to those requiring attention at the various medical, surgical, and other institutions to which the Fund contributes. Particular attention has been given to eye trouble amongst the employés. Proper examination and treatment have been afforded, and where necessary spectacles have been provided. Grants have also been made to members during sickness, and young employés from poor families have been clothed and fed, as found necessary. The Committee of the Fund are responsible for the administration and distribution of the allowances made by the firm to dependents of members who have joined H.M. Forces, and are also responsible for the maintenance of a Belgian refugee family at Bedford, to whose support all the members of the Fund contribute. Under the auspices of this Fund fortnightly grants are made to the Mayor of Leigh's branch of the Prince of Wales's National Relief Fund, and to date a total amount of £37 11s. 7d. has been handed over. Out of the balance in hand of £74, grants, to the value of £48, to infirmaries, hospitals, &c., have been made. The officers were unanimously re-elected for the ensuing year. The Fund is generously and sympathetically assisted by the Anchor Co., its directors and management.

Catalogues and Lists.—Messrs. J. H. Holmes and Co., Newcastle-on-Tyne.—Pamphlet No. 72 (four pages), gives half-tone views of various types of switchboards for lighting and power service, and for mining, mill and marine installations.

Mr. H. C. Slingsby, 142, Old Street, London, E.C.—Sheet of designs of trucks, ladders and barrows.

Messrs. Marshall, Sons & Co., Ltd, Britannia Ironworks, Gainsborough.—Catalogue No. 891 (16 pages), containing full descriptive particulars, with illustrations, and tabulated sizes, dimensions, &c., of fixed and portable types of oil engines.

Messrs. Simplex Conduits, Ltd., 116, Charing Cross Road, W.C.—New electric light fittings catalogue of 276 pages. It begins with information relating to the Simplex "Unit" system of electric light fittings and notes on fittings design, and closes with a numerical reference number index, and between these two extremes there lie hundreds of illustrations and prices of a wide and varied selection of electric light brackets, pendants, electroliers, ceiling fittings, table standards, shop window and outdoor signs, glassware and silk shades, and some 50 pages displaying many designs of electric heating and cooking appliances.

Premier Cooler and Engineering Co., Ltd., Broadway Court, Westminster, London, S.W.—Pamphlet No. 700 describes the Premier wet-air filters, and No. 701 is a 16-page catalogue fully describing, with diagrams and half-tone illustrations, the Premier dry-air filter plants. Both types of filters are stated to be largely used in electric power stations.

Book Notices.—"Sell's Directory of Registered Telegraphic Addresses," which has just been issued for the year 1915 (166, Fleet Street, E.C., 25s.), is, as usual, a very imposing volume. In the sections relating to (*a*) British Empire Overseas and (*b*) Foreign Countries, names and cable addresses of no fewer than 30,000 firms appear. The usefulness of such a publication needs no emphasis when communication by cable between this country and Overseas markets is so important a matter to all manufacturers and traders. The volume (2,600 pages) also contains an index to 80,000 telegraphic addresses registered in the United Kingdom, the information as usual being compiled from official lists. A classified list of trades is entitled "The National Directory of Commercial Houses," and it contains about 100,000 names.

"*Proceedings* of the Physical Society of London." Vol. XXVII. Part 2. February 15th, 1915. London: *Electrician* Printing and Publishing Co. Ltd. Price 4s. net.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXIV, No. 2. February, 1915. New York: The Institute. Price $1.

"Scientific Papers of the Bureau of Standards." No. 238. "Characteristic Equations of Tungsten-Filament Lamps and their Application in Heterochromatic Photometry." Washington, U.S.A.: Government Printing Office.

"The Engineer's Year-Book of Formulæ, Rules, Tables, Data, &c., for 1915." Edited by H. R. Kempe, M.Inst.C.E. London: Crosby Lockwood & Son. Price 15s.

A Meldrum Destructor in Australia.—A refuse destructor has been erected for the North Sydney Council by Messrs. Swarbrick & Co., representing Messrs. Meldrums, Ltd. It is of the Meldrum Simplex, breast-feed type with four grates, each grate being capable of treating 12 to 15 tons of garbage, or a total of 50 to 60 tons in 24 hours. The actual cost of burning has been 1s. 7d. per ton. Provision has been made for dealing with noxious gases and smoke, which are consumed and rendered harmless and inoffensive. It is proposed to utilise the steam generated in connection with tar plant adjoining the destructor, and for other municipal purposes. The cost was about £7,000.

New Zealand.—A Christchurch firm which formerly acted as agent for German firms wants to get into touch with British makers of pocket lamps and batteries, small motors (1½ to 6 volts) and dynamos, metal-filament lamps, and electrical novelties. Communications to H.M. Trade Commissioner for New Zealand, P.O. Box 369, Wellington.

Bankruptcy Proceeding.—G. J. T. Parfitt, consulting electrical engineer, Keynsham, Bristol.—Receiving order made February 17th, on creditor's petition.

Trade Openings in Argentina.—The *Financial Times* states that the Secretary of the British Chamber of Commerce in the Argentine has written to the London agents of the Chamber drawing attention to the volume of Germany's trade with the Republic, and giving advice to British manufacturers in regard to the dispatch of samples, &c. He says:—"Postal parcels from Great Britain addressed to business houses in this country are presumed, in the absence of any special indication, to contain articles of a dutiable nature. It is a common occurrence that the addressee is mulcted to the extent of 8s. or 10s. to obtain possession of a packet containing, for example, samples of no value, catalogues, printed matter, or descriptive pamphlets. This could be avoided by the simple expedient of indicating on the wrapper the contents of such parcels. These indications should be, of course, in the language of the country, and for the convenience of British firms who may be desirous of sending their samples, catalogues, &c., either direct to the Chamber or to individual British firms, I give the Spanish equivalents of some of the phrases in most common use:—Samples of no value—Muestras sin valor. Catalogues — Catálogos. Printed matter, descriptive pamphlets—Impresos."

Russia.—In his report on the trade of that Consular District in 1913, H.M. Consul at Riga (Mr. V. H. C. Bosanquet) remarks that it should be realised by British firms that the opportunity offered by the war to capture Germany's share of the import trade to Russia is one which it would be foolish to disregard. The volume and variety of manufactured goods hitherto supplied to Russia by German firms is immense, and it is quite impossible to enumerate all the different classes and sub-classes of goods in which Germany holds the field. Her position as Russia's nearest neighbour, her commercial enterprise, her extreme adaptability, and the study she has made of Russian markets, have all contributed to secure her the commercial position which she has held. It is satisfactory to learn that an organised effort is being made in the United Kingdom to profit by the present opportunity, and it may be hoped that the great field for enterprise offered by Russia will not be neglected by British manufacturers and merchants. Germany has supplied a very large proportion of the electrical machinery and accessories used in the district, the total imports of which amounted to 3,235,000 roubles in 1913. There should now be a great opening in this class of goods for United Kingdom manufacturers.

The British Vice-Consul at Archangel (Mr. T. Woodhouse) reports that an agent in that town wishes to secure the representation of United Kingdom manufacturers and exporters of fire bricks, steel, steel tools, and electric lamps and fittings.

H.M. Consul-General at Odessa (Mr. J. F. Roberts, C.M.G.) reports that a technical engineer at Ekaterinoslav wishes to secure the agencies of United Kingdom manufacturers of motors, boilers, pumps, technical accessories, electric light plant, &c. Communications regarding the inquiry should be addressed to the British Consulate-General, Odessa.—*Board of Trade Journal.*

Australia.—H.M. Trade Commissioner for Australia (Mr. G. T. Milne—address, Commerce House, Melbourne) reports that a number of importing firms in Melbourne, who in the past have imported the undermentioned classes of goods from foreign sources, have requested that United Kingdom manufacturers of these goods should communicate with them:—Thermometers, mathematical instruments, X-ray tubes and apparatus, electric glow lamps, glass, glassware, bitumen.

Change of Name.—The Institute of Industry and Commerce, which was inaugurated a few months ago, has now changed its name to the Institute of Industry and Science.

Deed of Assignment.—R. D. Cundall (The Cundall Gas and Oil Engine Co.), engineer and ironfounder, Keighley.—Particulars of claims must be sent in by March 31st, to the trustee, Mr. J. Rhodes, 37, Manor Row, Bradford.

LIGHTING and POWER NOTES.

Australia.—The Petersham (N.S.W.) Council has inaugurated its electric lighting scheme, which includes public lighting by arc and numerous high powered metal lamps. A joint scheme of the Petersham, Leichardt and Annandale Councils to be completed in June includes 2,000, 1,000 and 300-c.p. nitrogen-filled metal lamps. Over 1,000 poles and 50 miles of cable have been used in the Petersham contract, which was entrusted to the Electric Light and Power Supply Corporation of Balmain.

The Parramatta Supply Co. has started work; some 320 incandescent and 20 1,000-c.p. lamps are installed in the streets.

The proposal of the Melbourne Council to supply free metal lamps to consumers paying an extra ½d. per unit in place of carbon lamps, has brought a protest from the local Electrical Traders' Association. The Council at the present time supplies 65,000 carbon lamps per annum.

The Sydney Municipal Council has notified electrical contractors that in future it will require the provision of a red pilot lamp with any non-luminous heating apparatus, and where separate pieces of apparatus are used simultaneously a pilot lamp must be provided for each.—*Commonwealth Engineer.*

Ballymena.—Workhouse Lighting.—The B. of G. has decided to postpone the lighting of the old infirmary with electricity for six months.

Barford.—E.L. Scheme.—An E.L. scheme for this parish has been completed by the Barford Electric Supply Co., Ltd. For public lighting 11 lamps have been provided, and are lit for 25s. each per annum; current is supplied for lighting at 7d. per unit, and for cooking, heating and power at 2d. Connections secured are equivalent to 1,784 16-c.p. lamps, and extensions to the villages of Wasperton and Sherbourne are projected.

Barking.—Proposed New Plant.—A Sub-Committee of the Electricity Committee is considering the electrical engineer's report upon the question of the extension of the plant and mains in order to cope with the increasing demand for power.

Bingley.—The Electricity and Tramways Committee has decided to accept the offer of the Keighley Corporation to maintain a continuous supply of electricity on Sunday mornings.

Blackburn.—New Power Station.—An extension of the electricity undertaking, involving the erection of a new station and equipment at Whitebirk, at a cost of £100,000, is being considered.

Brighton.—The T.C. has considered the application of the B. of G. that the energy consumed at the various premises which the Guardians have taken owing to the acquisition of the workhouse by the military authorities should be charged for at the hotel rate. The application was refused, the Electric Lighting Committee reporting that separate cables and meters had been provided for the houses taken, and owing to the increased price of coal, the question of increasing the price to all consumers would have to be considered.

Burnley.—The Guardians have adopted a recommendation of the Assessment Committee that Messrs. Cross and Sons, Ashworth & Morris, re-value the gas and electricity undertakings of the Nelson Corporation.

Cheshire.—The C.C. has decided to petition against the Bill of the Stalybridge Joint Tramways and Electricity Board.

Continental.—Italy.—A little storm in a teacup has just been settled in Italy in connection with the annual tax on electricity which is in force in that country. It appears that the tax collectors in the Milan and Palermo districts recently had the bright idea of augmenting the revenue from this tax by serving a demand note for 20 lire (about 16s.) on all the motorists in the districts named whose cars are fitted with electric lighting installations. Their justification for the demand was that such sets were miniature electricity generating stations, and hence fell into the minimum annual tax category, this being the same as the tax on a central electricity station in a little town or village of 5,000 inhabitants. The matter was taken up with the Government by several of the leading automobile clubs in Italy, with the result that the action of the tax collectors has been declared illegal, the motorists thus again breathing freely.

Dover.—Refuse Destructor.—The T.C. has appointed a deputation to inspect dust destructors at other places, with a view to one being provided for the town.

Dublin.—Proposed Price Increase.—The Electricity Supply Committee has decided to recommend the Corporation to increase the charge by 1d. per unit for lighting, and ½d. per unit for power. The estimated expenditure for the next 12 months is £37,500 over that of last year, owing to coal prices, higher cost of carbons, maintenance, materials, &c. The Committee proposes also to ask the Council to reduce the rates immediately coal drops to normal prices.

By order of the Electricity Committee the number of street lamps in use after 10.30 p.m. has been reduced from 600 to 300, the object being to economise the consumption of carbons, the supply of which has been greatly interfered with by war conditions.

Frodsham.—Electric Pumping.—The Joint Water Committee has appointed a Sub-Committee to report on the cost of working pumps by gas and electricity. The pumps are being worked at present by electric motor.

Glasgow.—The Clyde Valley Electric Power Co. is installing electricity for lighting and power in the works of the Ellangowan Paper Co., at Milngavie.

Greenock.—It was reported at a meeting of the Corporation that the output of electricity during January showed an increase of 41 per cent. over the same period last year.

Harrogate.—The Knaresborough R.D.C. has decided to consent to the application for a prov. order for electric light being made by the T.C., and has agreed to a modified scheme by which the area of supply will be extended in the Council's district. The area of the Wetherby R.D.C. has been deleted from the order on account of the attitude of the Council, and Pateley Bridge has been secured. The charges that rule in Harrogate are to be instituted for the proposed area in the rural district.

Horsham.—Refuse Destruction.—The first year's working of the destructor, according to the report of Mr. J. B. Morgan, the electrical engineer, shows that 104,534 KW.-hours were generated, an average of 72½ per ton of refuse burnt. The coal figures for 1913-14 were 942 tons at £931, and for 1914-15, 678 tons at £656, showing a saving of £275, to which should be added £46 in respect of increased output, bringing the saving up to £321. Including clinker sold, and deducting financial charges, labour, &c., the net profit was £140.

Huddersfield.—Year's Working.—The accounts of the electricity department for the year ended December 31st show income £52,518, and expenditure £32,422, leaving a balance of £20,095, as compared with £18,215 for 1913. Of this £1,925 is to be transferred to the depreciation and contingencies account, and £2,100 carried forward for the relief of the rates.

The Electricity Committee has decided that the sum of £2,977 for a new switchboard, in replacement of the old one, shall be charged to depreciation account.

Hull.—Electric Cooking.—The Electricity Committee has instructed the engineer to report on the question of supplying electricity for cooking and lighting to the houses of the working classes.

Kingstown.—Arbitration Result.—The arbitrator (Mr. S. L. Brown) has decided that the Urban Council shall pay £3,607 to the Dublin Southern District Electric Supply Co. for the transfer of the undertaking in the town, the Council to pay all costs.

Leicester.—Public Lighting.—The Watch Committee of the Corporation recommends that the main thoroughfares on tramway routes be lit by electric incandescent lamps suspended in the centre of the road between the poles, and has arranged with the Tramways and Electricity Committee to undertake the lighting of the streets in question for an annual payment of £6 8s. 7d. per 600-C.P. lamp, to include the supply, repair and maintenance of mains, overhead services, fittings, and the lamps themselves, and the supply of the necessary current. It is found that for the existing tramway routes the provision of 938 600-C.P. half-watt lamps will be required, and the annual cost of street lighting will be increased by approximately £2,000 per annum, but the Committee considers the improved lighting will amply compensate for this outlay.

Liverpool.—Restricted Lighting.—This city and the surrounding areas have now adopted a reduced scale of lighting. Public arc lighting has been dispensed with and metal-filament lighting substituted, but the illumination of the tramway cars has not been reduced.

Llandudno.—Proposed Loan.—The Council has decided to apply to the L.G.B. for sanction to borrow £1,720 for an engine and dynamo, &c., and an induced-draught plant, and is to spend £269 out of revenue on a new office, and alterations to the battery room.

London.—The L.C.C. Finance Committee recommends the sanctioning of the application of the Battersea B.C. for a loan of £15,750, viz., £8,750 for rotary converters, switchgear and transformers, and £7,000 for H.T. feeder cables.

Hammersmith.—The Electricity Committee states that a satisfactory trial has been made of the plant recently installed for pumping coal from the Council's wharf to the electricity works, and it is expected that the same will soon be in use.

The Council is recommended to take up a loan of £10,000 from the L.C.C. in connection with the electricity undertaking.

London Electric Supply Bills.—The L.C.C. has notified the various Councils that consideration is still being given to the question of what further action, if any, shall be taken with regard to the supply of electricity in and near London, and states that any observations which the authorities of the districts concerned wish to make on the subject should be submitted as soon as possible.

The Chairman of Parliamentary Committees has undertaken to ask promoters of contentious Bills before Second Reading not to proceed with their proposals. The London Electric Supply (No. 2) Bill, promoted by the West End companies, comes under this heading, as already 50 dissenting petitions have been presented. The promoters of the Bill represent only 32 out of the 117 sq. miles in the County of London, and it is being opposed by both municipalities and companies.

Manchester.—Restricted Lighting.—The order for reduction of the lighting of streets and public buildings comes into force on March 1st. The order will affect the mills, in which many of the windows will require screening at night.

Nantwich.—The R.D.C. has deferred consideration of the question of a scheme for extending the E.L. to Wistaston, pending the result of a conference with Mr. Denton, electrical engineer, of Crewe.

New Zealand.—The Christchurch City Council is having difficulty in the distribution of light and power from the Lake Coleridge supply owing to the shortage of insulators. The Dominion supplies appear to have come largely from Germany in the past, and the possibility of having insulators made in New Zealand is being discussed, and the Christchurch Brick Co. has been approached. The Government geologist has been communicated with in order to ascertain whether there are deposits of suitable clay in New Zealand. In the event of a favourable reply being received, there is a possibility of a new industry being established in the Dominion.

Nelson (Glam.).—E.L. Scheme.—The inauguration of the supply of electricity by the South Wales Electrical Power Co. took place at Abernant on the 13th inst. The company will shortly give a supply in the Abercarn Urban District and in portions of the Llantrisant, Crowbridge and Penybont districts.

Plymouth.—The quarterly return of the electricity undertaking in the Devonport and Stonehouse areas, to the end of December shows that 1,778,350 units were sold producing £15,150, compared with 1,601,629 units sold and £13,855 received in the corresponding period of the previous year, an increase in receipts of £1,294.

Rawtenstall.—It is recommended by the Tramways and Electricity Sub-Committee that the charge per lamp per annum be increased to £2 5s. 9d. for 100-C.P. lamps, and to £1 18s 9d. for 50-C.P. lamps, for the year ending March 31st, 1916.

Reigate.—The R.D.C. has been asked if the Council's letter of December 29th is a formal refusal to consent to the Chipstead and District E.L. Order, in which event it is proposed to apply to the B. of T. to dispense with the Council's consent. The Council has replied that it is of opinion that nothing should be done to facilitate the granting of the order until the new Urban Council of Coulsdon and Purley was able to consider the matter, and for that reason the Council proposed to ask the B. of T. to refuse the order being applied for.

Romsey.—E.L. Scheme.—The T.C. has referred to the General Purposes Committee a proposal by a private firm to introduce electric light into the town.

Skerries (Co. Dublin).—E.L. Scheme.—The new electric lighting system, introduced by Mr. W. Flanagan under an arrangement with the U.D.C., was inaugurated on Monday night.

Southend-on-Sea.—The T.C. has decided to extend the mains along the Lower Esplanade to the new swimming baths, at an estimated cost of £291.

Stirling.—Proposed Works Extension.—In view of a report by the electrical engineer that the time had come to consider the advisability of increasing the capacity of the works, the Lighting Committee is to consult Mr. J. A. Robertson (Salford) on the matter.

Tullamore.—Workhouse Lighting.—The B. of G. has been informed that the installation of electric lighting in the workhouse would effect a net saving of £140 per annum.

West Ham.—In reference to the Council's dispute with the Hart Accumulator Co., Ltd., in regard to the amounts deducted by the company from the electricity accounts for alleged damage caused by interruptions in the supply of current, the Electricity Committee, having carefully considered certain conditional arrangements made has recommended the Council to confirm them, and to instruct the solicitors to proceed accordingly.

Willesden.—New Plant.—The Electricity Committee has had under consideration complaints from consumers with reference to interruptions in the supply. The engineer reports that in order to ensure greater security from interruptions, and to cope with the increased demand, it would be advisable to install a battery at Acton Lane; the cost would be—for buildings, £1,000; battery, £2,750; booster, switchgear and connections, £1,000; new feeder cable, £1,112; total £5,862. The Committee considers the expenditure is urgent, but in view of the present conditions is reluctant to enter into any heavy commitments, and recommends that application be made to the L.G.B. for sanction to borrow £5,862, the commencement of the works in question to be deferred for such a period as will allow completion of them before next winter.

Yorkshire Electric Power Bill.—The Birkenshaw and Mytholmroyd Councils have decided to ask the Power Co. to strike them out of the first schedule of the Bill; the Bingley, Earby and Thurnscoe Councils have decided to oppose the Bill.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyne.—The employés of the Ashton, Oldham and Hyde Tramways, the Stalybridge Joint Tramways Board and the Ashton Corporation Tramways have decided to make an effort to secure an increase of 1d. per hour in wages for all grades, on account of the greatly-increased cost of living. The employés concerned number about 300.

Australia.—In connection with the suburban railway electrification scheme, the first consignment of G.E.C. apparatus, consisting of 90 traction motors, has now reached Melbourne from America. The first instalment of new motor coaches, 120 in number, is being constructed in the Newport workshops. A number of existing cars are being reconstructed for electric traction.

Tenders were recently invited for the steel gantries for the overhead equipment, &c., of the Sandringham-Broadmeadows line.

The Melbourne Tramways Co.'s lease expires in June, 1916, and the Melbourne Tramway Trust is considering the question of negotiating the purchase of the company's buildings, cars and plant.

The Assistant Minister of N.S.W. Railways has stated that it was intended first to convert to electric traction the North Shore section from Milson Point to Hornsby. If successful it would be followed by other suburban lines round Sydney, and by the section from Sydney to Newcastle, nearly 100 miles long.

The Victorian Railway Commissioners are shortly to introduce 10 new bogie cars on the St. Kilda-Brighton line, which will contain three passenger compartments and two drivers' compartments, and sliding central doors for the passengers' entrance.

Birmingham.—Electric Vehicles.—According to the *Commercial Motor* an order for 2½-ton "Orwell" electric tipping wagons has been given by the Corporation to Messrs. Mossay & Co.

Blackpool.—Traffic Returns.—The tramway receipts during January were £2,546, an increase of £399 over the previous month. The revenue from April 1st to the end of January was £71,210, against £80,100 during the same period of the previous year. The greatest decrease followed the outbreak of war, but since the troops came in November there has been a recovery to the amount of about £100 per week.

Brighton Railway Electrification.—At this company's meeting held on Wednesday, the chairman mentioned that they were proceeding with the electrical equipment of their suburban lines, for which contracts had been placed. Their existing electrical services had shown marked expansion.

Canada.—According to the report for the year ending October 31st, 1913, of the Minister of Public Works for the Province of Ontario, there were 761·16 miles of electric railway completed, and 47·00 miles under construction of that date. Of 37 different companies, 8 were using hydro-electric power.

Continental. — Switzerland. — It is stated that 1,873 miles of the Swiss State lines are to be converted from steam to electric traction, power being derived from the wealth of water power available. The first section will include the St. Gothard Tunnel, the section being 67·7 miles in length. Current will be transmitted single-phase at 60,000 volts to various sub-stations, whence it will be distributed.—*Railway News.*

Edinburgh.—Experimental Cars.—The Tramway Sub-Committee of the T.C. has decided to experiment with self-propelled cars, with a view to the possible introduction either of electrically or petrol-driven vehicles.

Hull.—Rate Relief.—The Corporation has decided to grant £10,000 from the tramway profits for the relief of rates, being £3,000 more than last year, and to carry forward £5,323 to the reserve fund, which will then stand at £140,000.

It is estimated that 100,000 soldiers per week have been carried free on the cars during the last eight months, this privilege not having been withdrawn in Hull.

Leeds.—Goods Traffic.—A scheme for dealing with extraordinary traffic is under consideration ; it is proposed to construct hopper wagons, to be drawn over the tramway lines by electric locomotives. The wagons are to have a capacity of 10 tons each, and a charge is to be made of about 4d. per ton-mile.

London.—L.C.C. Tramways Assessment.—The House of Lords, on Monday, allowed the appeal of the L.C.C. on its claim to have a reduction of the valuation of the tramways in the borough of Islington, by reason of the rateable value having been reduced by the competition of the motor-'buses.

In reply to a question in Parliament by Mr. Kellaway, Mr. McKenna stated that in the last four months of 1913 57 persons were killed by motor-omnibuses, and 25 by electric tramcars in the Metropolitan Police District. In the last four months of 1914 79 persons were killed by omnibuses and 17 by tramcars.

The L.C.C. has intimated to the B.C.'s that the clause in its Tramways Bill to which there is opposition on the ground that it would affect their veto with regard to the overhead system, would be modified to meet the wishes of the B.C.'s concerned.

Morecambe.—Tramway Extensions.—The T.C. has approved of a scheme which provides for an extension of the tramway system.

Newcastle-on-Tyne.—Tramway Estimates. — The Tramways Committee's estimates for the coming year show traffic receipts £270,980, and a total income of £282,200. For the year just closing the estimated receipts were £255,150, but it is expected that this sum will be exceeded by at least £2,200. The total expenditure will be £160,300, an increase of £15,400 on the current year's estimate. From the surplus of £121,900 the sum of £75,000 will be required for interest and redemption, and £8,000 for income-tax ; but as a set off to these items is £3,500 interest on investments. These figures yield a net surplus of £39,400, but a further deduction of £8,000 must be made on account of allowances to employés who are on active service. At the beginning of the current year the reserve fund stood at £94,000, or £6,000 short of the amount the Committee considers should be maintained. By the end of the current year it is estimated that the shortage will have reached £22 000, a deficiency which, it is hoped, may be made up by the surplus on the present year. It is estimated that £34,000 will be spent during next year on renewals.

West Ham.—New Cars, Motors, &c.—The tramway manager has reported upon the provision of new tramcars, and says that he has recently succeeded in getting amended offers for the car bodies and trucks, bringing the price down to £1,145 per car, which is equal to an increase of about 15 per cent. on the prices prevailing in 1912-13. As the undertaking is badly in need of more cars, the manager recommends the Committee to accept the tenders of the Brush Co. for bodies and trucks ; British Thomson-Houston Co., for equipments and brakes ; and British Westinghouse Co., for controllers, the total for the 15 cars, including spares, amounting to £17,705. The manager states that in May last year his attention was drawn to a greatly improved type of motor. It would, the manager remarks, more than pay the Corporation to replace the whole of the present equipments by an equipment of this class, which has a reserve amply sufficient to meet any growth of traffic that may reasonably be anticipated during the next 10 years. The manager estimates that the saving that could be effected, after completing the change-over of the equipments, would be in the neighbourhood of £4 000 per annum, making no allowance for the benefits that are bound to accrue from fewer breaks in the service. The replacement of the equipments would take about 18 months, and cost £28,000. It is proposed to refer the matter to the Finance Committee, with a view to providing the necessary money to carry out the manager's suggestion.

York.—Electric 'Buses.—During the past week the first of the new electric 'buses purchased by the Corporation has been running to and from Heworth, and has been well patronised. The journey is completed in about 10 minutes.

TELEGRAPH and TELEPHONE NOTES.

Landing Licences for Trans-Atlantic Cables.—Notice is given in the *London Gazette* that the Commercial Cable Co. has applied to the Board of Trade for the renewal of its landing licences for submarine cables at Weston-super-Mare and Waterville, connecting these places with one another and with North America and the Azores. On March 22nd the Board will proceed to consider the application, and in the meantime will receive any objections that may be made thereto.

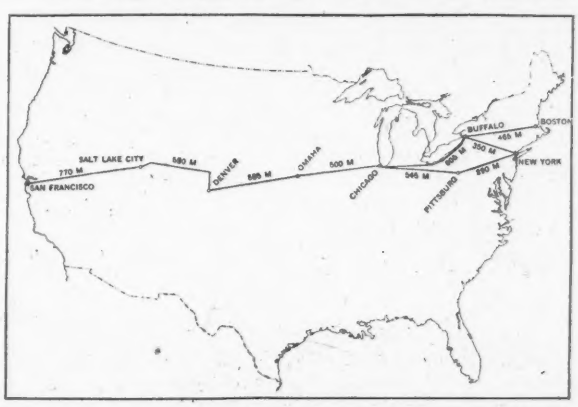
London Telephones.—Answering a question in the House of Commons, the Postmaster-General stated that out of the 11,000 telephone lines in the south of the metropolitan area which were put out of service by the snowstorm on January 22nd, some 2,000 were still unrepaired. Great efforts were being made by the engineering staff to push on the work of restoration.

Rawtenstall.—The T.C. has resolved that a new scheme of street fire alarm and telephone service be adopted, and that a tender for the work be obtained from Messrs. Siemens Bros. and Co., Ltd.

Telegrams for Places Abroad.—It is announced that telegrams may now be forwarded to British New Guinea, Macquarie Island, and the Sandwich Islands, at rates varying from 2s. 3d. to 3s. 3d.

Trans-Continental Telephony.—On January 25th, as previously noted in this column, telephonic communication between the Atlantic and Pacific coasts of the United States was formally inaugurated ; the route of the line is shown on the accompanying map, and some particulars of its construction are given below, for which we are indebted to our American contemporaries.

The line took two years to construct ; in addition to the building of the section from Denver to the coast, the whole of the line between New York and Denver had to be overhauled and equipped with loading coils. The wire was hard-drawn copper 0·165 in. in diameter ; one two-wire circuit weighs 1,480 tons, and in two physical two-wire circuits there are 13,600 miles of wire, carried on 130,000 poles. The phantom circuit derived from these two circuits gives the best results over long distances. The wild and mountainous character of the country in the Far West made the work of construction exceedingly difficult ; long stretches of the line run over swamps and deserts, and there are no roads. The loading coils are mounted on the poles. The first large city touched by the line after leaving San Francisco is Salt Lake City, 770 miles to the east. The poles are of red-wood, and usually measure 4 in. square at the top, 8 in. at the bottom, and are 18 ft. long.



The line consists of two physical circuits and one phantom circuit; all the circuits are loaded with Pupin coils 4 or 5 in. in diameter, with cores of iron wire 4 mils in diameter. Beginning at Boston, the first line ran to Cambridge in 1876, and was extended to Providence, 45 miles, in 1882, and to New York, 235 miles, in 1884. The line between New York and Chicago, 900 miles, was opened in 1893, and was extended to Omaha in 1898, to Denver in 1911, and to Salt Lake City in 1913.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 6th. U.D.C. Twelve months' supply of cables, meters, joint-boxes, &c., lamps, uniforms, tickets and other stores. See "Official Notices" February 5th.

Australia.—Brisbane.—March 10th. Motor-generator, power board, &c., for Postmaster-General. See "Official Notices" January 15th.

April 7th. Wheatstone receivers and transmitters, for the Postmaster-General. See "Official Notices" February 19th.

Melbourne.—March 16th. White Wheatstone receiving tape, for Postmaster-General. See "Official Notices" February 5th.

Bedwas.—March 4th. Electrical goods for 12 months, for the Bedwas Navigation Colliery Co., Ltd. Forms of tender from the Secretary.

Belfast.—March 15th. Twelve months' supply of stores for the Tramways and Electricity Committees. See "Official Notices" February 19th.

Birkenhead.—March 9th. Corporation. Continuous-current meters and house-service fuse boxes. See "Official Notices" to-day.

Bolton.—March 4th. Corporation. Twelve months' supply of stores for the Electricity Department. See "Official Notices" February 19th.

Bury.—March 8th. Constructional steelwork (contract 2AA) in connection with the electricity generating station extension at Chamber Hall, and steel window frames (contract 4A). Specifications, &c. (£2 2s. for each contract, returnable) from Mr. J. Ainsworth Settle, Borough Engineer, Bank Street.

Dover.—March 9th. Electrical sundries and cables for a year, for the Harbour Board. Mr. Martyn Mowll, Registrar, Castle Street.

Dundee.—March 3rd. Corporation Tramways Committee. Stores for a year from May next. Specification from Mr. Peter Fisher, General Manager.

Edinburgh.—March 4th. Corporation. Electric lighting installation at Labour Exchange offices (Old Corn Exchange Buildings, Grassmarket). Tenders to the Town Clerk.

Edmonton.—March 10th. Electric lamps for the B. of G. Mr. F. Shelton, Clerk, The Grange, White Hart Lane, Tottenham.

France.—March 17th. Two electric travelling cranes for the repair shops at Mézidon, for the Administration des Chemins de Fer de l'Etat. Particulars from the Bureaux du Service Electrique, 43, Rue de Rome, Paris (1re).

Gloucester.—April 1st. Twelve months' supply of stores, for the Electricity and Light Railways Committee. Forms of tender from Mr. F. H. Corson, General Manager, Light Railways Offices, Bristol Road.

Grimsby.—March 8th. Corporation. Two years' supply of motor-type meters. See "Official Notices" to-day.

Guildford.—Water softening and filtering plant, 50,000 gallons per hour, for Guildford Electricity Supply Co., Ltd. See "Official Notices" February 19th.

Heston and Isleworth.—March 6th. U.D.C. Twelve months' supply of electrical stores. See "Official Notices" to-day.

Huddersfield.—March 2nd. Corporation. Electricians' work at new Tuberculosis Hospital. Forms of tender from Mr. K. F. Campbell, Borough Engineer.

Hull.—March 2nd. Air-space telephone cable, for the Telephone Committee. See "Official Notices" February 19th.

London.—L.C.C.—March 16th. Reconstruction of three miles of single-line tramway on the underground conduit system. Specifications, &c. (£5), from Chief Engineer, County Hall, Spring Gardens, S.W.

Finsbury.—March 1st. B.C. Six or twelve months' supply of electric fittings. Forms of tender from the Borough Surveyor, Town Hall.

Battersea.—March 2nd. B.C. Supply of stores for Electricity Department. See "Official Notices" February 12th.

Hornsey.—March 16th. Meters, cables and stores, &c., for the T.C. See "Official Notices" February 19th.

Bow.—March 9th. Electrical supplies, for the Managers of the Poplar and Stepney Sick Asylum District. Forms of tender from the Clerk, Devons Road, Bow, E.

Macclesfield.—March 10th. Cheshire County Asylum, Parkside. Electrical goods for one year. Mr. Wm. Tingay, Clerk.

Manchester.—March 2nd. G.C. Railway Co. Six or twelve months' supply of wires, cables, carbons, electrical accessories, lamps and telegraph material. Mr. W. Williams, Stores Superintendent, G.C.R., Gorton.

Newport (Mon).—March 2nd. Electric light fittings, for the B. of G. Mr. A. H. Rees, Clerk, Queen's Hill.

New Zealand.—May 3rd. Electrically-driven turbine pumps of 80,000 and 100,000 gallons capacity per hour, together with direct-coupled motors. Commercial Intelligence Department, Board of Trade, London.

Pontypridd.—March 8th. U.D.C. Twelve months' stores for Electric Light and Tramways Department. See "Official Notices" February 19th.

Spain.—Tenders have just been invited by the municipal authorities of San Pedro de Latorce (Province of Valladolid) for the concession for the electric lighting of the town during a period of 15 years.

Swindon.—March 13th. Corporation. Twelve or six months' stores for Electricity and Tramways Departments. See "Official Notices" February 19th.

Transvaal.—Bethal. March 25th. Municipality. Supply and erection of generating and pumping plant and overhead electric distribution system. Specifications from the consulting engineer, Mr. H. Hancock, A.M.I.C.E. P.O. Box 62, Klerksdorp (deposit £1 1s.). Tenders to Town Clerk, P.O. Box 3, Bethal, Transvaal.

Tynemouth.—The Electricity Committee has resolved to enter into contracts for the supply of electrolytic and other meters during the next 12 months.

Wigan.—March 2nd. Twelve months' stores and materials for the Tramways Department. Mr. F. Buckley, General Manager, Market Place.

Wrexham.—March 17th. Meters, oils, coal, &c., for the Corporation Electrical Department, for a year. Borough Electrical Engineer, Willow Road.

CLOSED.

Australia.—The Public Works Department has accepted the following tenders:—

Motors and control gear for Newcastle Government Dockyard.—Standard-Waygood-Hercules, Ltd., £2,906.
Motors and switchgear for Homebush new public abattoirs.—Australian General Electric Co., £662.

Government Contracts.—The following tenders have been accepted during the past month by the Government Departments named:—

War Office.

Electric cable and wire.—T. Bolton & Sons, Ltd.; British Insulated and Helsby Cables, Ltd.; Craigpark Electric Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Liverpool Electrical Cable Co., Ltd.; Shropshire Iron Co., Ltd.; Siemens Bros. & Co., Ltd.; F. Smith and Co. (incorporated with London Electric Wire Co. & Smiths, Ltd.); Ward and Goldstone; Yorkshire Cable Co.
Electric cells.—J. C. Fuller & Son, Ltd.; I.R., G.P. & Telegraph Works Co., Ltd.; Siemens Bros. & Co., Ltd.
Electric light generating sets.—Austin Motor Co.; Boulton & Paul.
Generators.—Austin Motor Co.
Gutta-percha (sheet).—Craigpark Electric Cable Co., Ltd.
Electric lamps.—Corona Lamp Works, Ltd.; Edison & Swan U.E.L. Co., Ltd.; General Electric Co., Ltd.; "Z" Electric Lamp Mfg. Co., Ltd.
Electric lathes.—Drummond Bros., Ltd.
Telephone sets and parts.—Automatic Telephone Mfg. Co., Ltd.; Gent and Co., Ltd.; New Phonopore Telephone Co.
Tramway track.—Kerr, Stuart & Co., Ltd.
Wire (steel).—W. N. Brunton & Son; Connolly Bros., Ltd.; London Electric Wire Co. & Smiths, Ltd.; Siemens Bros.
Electric light installation.—For huts at Riby Park, S. Dixons & Sons, Ltd.; at Scott's House, Newcastle, Edmundson's Electricity Corporation, Ltd.
Electrical work on the Pinehurst Estate.—Siemens Bros., Ltd.

Crown Agents for the Colonies.

Turbo-alternator.—British Thomson-Houston Co., Ltd.
Telegraph poles.—J. Spencer, Ltd.

India Office.

Accumulators.—Edison Accumulators, Ltd.
Apparatus.—Marconi Wireless Telegraph Co.
Boosters.—Lancashire Dynamo & Motor Co.
Exchange extension.—Automatic Telephone Mfg. Co.
Telephones.—General Electric Co.

POST OFFICE.

Apparatus protective (lighting and power).—British L. M. Ericsson Mfg. Co., Ltd.

Ditto (telephonic).—Automatic Telephone Mfg. Co., Ltd.; British L. M. Ericsson Mfg. Co., Ltd.; Milner's Safe Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Western Electric Co., Ltd.

Cable (submarine).—I.R., G.P. & Telegraph Works Co., Ltd.; Telegraph Construction and Maintenance Co., Ltd.

Cable (telegraphic).—Telegraph Construction & Maintenance Co., Ltd.

Cable (telephonic).—B I. & Helsby Cables, Ltd.; W. T. Glover & Co., Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.

Ebonite parts.—British L. M. Ericsson Mfg. Co., Ltd.; Siemens Bros. and Co., Ltd.

Insulators.—Taylor, Tunnicliff & Co., Ltd.

Laying conduits (short lengths, non-continuous).—At Hornsey, Islington, &c., O. C. Summers; Lewisham, O. C. Summers; Willesden, Harrow &c., O. C. Summers; Glasgow, A. Duncan.

Laying ducts.—South Lambeth Road, J. Mowlem & Co., Ltd.; Gerrard Exchange, J. Mowlem & Co.

Laying ducts and pipes.—Bishopsgate and Kings'and Road, F. G. Brummell; Oxford, J. Mowlem & Co., Ltd.

Rearrangement and extension of power plant at the London Wall Exchange.—Western Electric Co., Ltd.

Telephone exchange equipment.—Perth, Peel-Conner Telephone Works, Ltd.; Hammersmith, Western Electric Co., Ltd.; Sutton, Western Electric Co., Ltd.

Spindles (insulator).—Bayliss, Jones & Bayliss; Guest, Keen & Nettlefolds, Ltd.

Troughing and covers.—Doulton & Co., Ltd.

Lead (tube).—Baxendale & Co., Ltd.

Bronze wire.—T. Bolton & Co., Ltd.; B.I. & Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.; London Electric Wire Co. & Smiths, Ltd.

Bronze insulated wire.—Connolly Bros., Ltd.

Copper wire.—Shropshire Iron Co., Ltd.

Copper insulated wire.—Siemens Bros. & Co., Ltd.

Hong-Kong.—The General Electric Co. of China, Ltd., has secured the contract for all the Government requirements for Osram drawn wire tungsten lamps and electrical supplies for Hong-Kong for the year 1915.

Kettering.—The Admiralty having placed an embargo on the rotary converter being supplied by the Brush Electrical Engineering Co., Ltd., the U.D.C. has accepted the offer of the company for the temporary use of a 500-KW. rotary plant until a Siemens rotary converter of the original type can be installed, the cost of the installation of the temporary plant to be borne by the contractors.

Llandudno.—The Council last Friday accepted the tender of the Electric Construction Co., Ltd., at £425, for a dynamo, and that of Messrs. Browett, Lindley & Co. for an engine for the municipal electric light works. At the previous meeting the Council had been divided on the question of introducing the Diesel engine, but the Committee subsequently decided on steam plant.

London. — BATTERSEA. — The Electricity Committee reports having accepted the tender of the British Westinghouse Electric & Manufacturing Co., Ltd., to supply additional plant in connection with the supply of energy to the Nine Elms district, at £6,525. The cable, &c., will be obtained from Messrs. Callender's Cable & Construction Co., Ltd., under the Council's contract.

HACKNEY.—The Electricity Committee recommends that the tender of Messrs. Rice & Co., at £698, for foundations, &c., for the 5,000-KW. turbo-alternator and auxiliary plant at the Millfields Road generating station, be accepted.

HAMMERSMITH.—The Electricity Committee reports having accepted the following offers for coal:—

Myers, Rose & Co.—100 tons of Shipley, at 14s. 4d. per ton, with option to supply 1,000 tons if satisfactory; 100 tons of Kirkby Nottingham slack, at 13s. 9d. per ton.

Cory Bros. & Co., Ltd.—2,400 tons of Kirkby Nottingham slack, at 13s. 6d. per ton; 800 tons of Gedling, at 13s. 6d. per ton.

South Metropolitan Gas Co.—100 tons per week, until December 31st, 1915, of coke breeze, at 7s. per ton.

Wandsworth, Wimbledon, Epsom & District Gas Co.—1,800 tons of coke breeze, at 7s. per ton.

The Committee recommends that the tender of the Cadogan Iron Works, at £42, be accepted for replacing the troughing of the Bennis coal-conveyor at the electricity works.

WILLESDEN.—The District Council has been recommended to accept the tender of the British Thomson-Houston Co., at £665, for renewing the H.T. switchboard at the Salusbury Road substation.

Rawtenstall.—The T.C. has resolved that the specification of Messrs. Siemens Bros. & Co., Ltd., for the supply and installation of a proposed new street fire-alarm and local telephone service be accepted, and their tender for carrying it out be adopted.

Scotland.—Messrs. Nobel's Explosives Co., Ltd., have placed an order with Messrs. Johnson & Phillips, Ltd., for overhead power mains for their factory in Scotland.

Ship Lighting.—The Booth S.S. Co. has placed a contract with the Edison & Swan Co. for Royal Ediswan metal-filament and carbon-filament lamps.

Southend-on-Sea.—The T.C. has accepted the tender of Messrs. E. & H. Davey, of Southend, for the erection of a substation at Thorpe Bay, at £4,695.

Walthamstow.—The U.D.C. is recommended to pay, as from February 1st last, an extra 1s. 6d. a ton on the contract with Messrs. Usher & Co., Ltd., for the supply of coal to the electricity works.

The Finance Committee has considered letters from the various contractors to the Electricity Department, and has recommended the acceptance of the following tenders, for the 12 months commencing April 1st, in respect of the items they are willing to supply on the same terms as at present:—Liverpool Electric Cable Co., Dussek Bitumen Co., B.I. & Helsby Cables, Electrical Mfg. and Supplies Co., C. C. Wakefield & Co., Stern Sonneborn Oil Co., A. B. Gross & Co., Vacuum Oil Co., W. Wood & Co., Anti-Attrition Metal Co., L. Andrew & Co., Imeson & Finch, Docker Bros., Robert Kearsley & Co., J. H. Tucker & Co.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, February 26th. At 5 p.m. At Imperial College of Science, South Kensington. Papers on "Magnetic 'Character' Figures, Antarctic and International," by Dr. C. Chree, F.R.S.; "The Electrification of Surfaces as Affected by Heat," by Dr. P. E. Shaw; "Electromagnetic Inertia and Atomic Weight," by Prof. J. W. Nicholson.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, February 26th. At 7.30 p.m. At Bolbec Hall, Newcastle-upon-Tyne. Report on "The Progress of Reform in the Engineer Branch of H.M. Navy," by Mr. D. B. Morison. Paper on "The Future of British Engineering and Shipbuilding" will also be read.

(Graduates' Association.)—Saturday, February 27th. At 7.15 p.m. Paper on "Electric Lighting and Power for Ships," by Mr. O. Holmes.

Association of Mining Electrical Engineers (South Wales Branch).—Saturday, February 27th. At 6 p.m. At Carlton Café, Queen Street, Cardiff. Paper on "Typical Breakdowns in Colliery Electrical Plant and their Prevention," by Mr. L. Foster.

Royal Society of Arts.—Monday, March 1st. At 8 p.m. At John Street, Adelphi, W.C. Fothergill Lecture (III) on "Motor Fuels," by Prof. V. B. Lewes.

Society of Engineers.—Monday, March 1st. At 7.30 p.m. At Institution of Electrical Engineers, Victoria Embankment, W.C. Paper on "Running Costs of Motor Vehicles," by Lieut. R. W. A. Brewer.

Roentgen Society.—Tuesday, March 2nd. At 8.15 p.m. At Institution of Electrical Engineers, Victoria Embankment, W.C. Paper on "The Chemistry of the Radio Elements," by Mr. A. Fleck.

Institute of Marine Engineers.—Tuesday, March 2nd. At 8 p.m. At Tower Hill, Minories, E. Paper on "Tail Shaft Lubrication," by Mr. A. J. Lebeda.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, March 3rd. At 7.30 p.m. At the University, Edmund Street. Paper on "Electricity Applied to Mining," by Mr. C. P. Sparks.

(Newcastle Local Section).—Monday, March 1st. At 7.30 p.m. At Mining Institute. Paper as above, by Mr. Sparks.

Nottingham Society of Engineers.—Wednesday, March 3rd. At the Welbeck Hotel, Milton Street. Paper on "Town's Gas—Its Manufacture and Varied Uses," by Mr. G. Stevenson.

Greenock Electrical Society.—Thursday, March 4th. At 7.45. At 21, West Stewart Street. Paper on "The Operation of a Large Electric Supply System," by Mr. G. Macdonald.

Royal Institution of Great Britain.—Saturday, March 6th. At 3 p.m. At Albemarle Street, W. Lecture (III) on "Recent Researches on Atoms and Ions," by Sir J. J. Thomson, F.R.S.

Monday, March 1st. At 5 p.m. General Meeting.

Salford Technical and Engineering Association.—Saturday, March 6th. At 7 p.m. At Royal Technical Institute, Peel Park. Paper on "The Strength of Iron Castings," by Mr. E. L. Rhead.

NOTES.

Fatality.—An inquest was held at Oldham, on February 19th, touching the death of Harold Wood (21), electrician. —Tom Ryan, a tinsmith employed at Messrs. Asa Lees & Co.'s works, Derker Street, Oldham, said that on the previous Wednesday the electricity was off until 2 p.m., and at that time deceased went to the main switch to turn the current on and then to set the motor going. In starting, it fired in the fuse-box. Deceased knocked off the switches of the motor and got hold of a fuse, and a few seconds afterwards staggered back and collapsed on the floor.—Charles Tucker, an electrical engineer at the works, said deceased worked under him and he regarded the affair as purely accidental. He was doing work he should have done, but not in the manner in which it should have been carried out. When the wire fused in the box deceased should have gone to the main service switch and pulled it out, as he had done on a previous occasion on similar faults. Deceased had been with the firm since June, 1913.—The Coroner (Dr. Carson) said the young fellow had evidently done what he ought not to have done and without doubt the affair was an accident. A verdict of "Accidental death" was returned.

Copper.—It would be anticipated that supplies of copper should show a temporary falling-off in quantity just at the present time, but an examination of the mid-monthly statistics, as tabulated by Messrs. Merton, does not confirm this impression. The European visible supplies, at 35,567 tons on February 15th, are 442 tons higher than for the end of January. English stocks are 83 tons less than on the same date, the increase being made up on Chile and Australian shipments.

In classified supplies American shipments to Europe are, so far as can be judged from mid-monthly statistics, low, but equal to those for September and October, and higher than those for August, November or December. Spain and Portugal have sent a quantity equal to the average pre-war supply, while the supply under the heading "Other Countries" is considerably above the peace average. Chile shipments are higher than in normal times and Australian show better than for the preceding four months Total deliveries for the half month, if continued at the same rate, would give a quantity for the month considerably exceeding that for October and November, and only beaten by last month out of all the six preceding ones

Changes in the Board of Trade Returns.—Commencing with January, various changes have been made in the classification adopted in the monthly import and export returns as issued by the Board of Trade. The following are the alterations made in connection with the electrical industry. First, as regards imports: electricity meters and measuring instruments, as also switchboards, which have hitherto been included under the general heading of "Electrical Goods and Apparatus, unenumerated," are now shown separately. Similarly, the old heading of "Machinery, Electrical of all kinds," has been divided into two sections: (1) Generators and motors (except for aeroplanes, motor-cars and motor-cycles), and (2) unenumerated. On the export side the following are now given separate headings in the division relating to "Electrical Goods and Apparatus": (1) Meters and measuring instruments, (2) transformers, and (3) switchboards. The classification, "Machinery, Electrical of all kinds," has been sub-divided into three sections: (1) Railway and tramway motors, (2) other generators and motors (except for aeroplanes, motor-cars and motor-cycles), and (3) unenumerated.

Institution and Lecture Notes.—Institution of Civil Engineers.—On Tuesday last a paper was read on "The Electrolytic Action of Return Currents in Electric Tramways on Gas and Water Mains; and the Best Means of Providing against Electrical Disturbances," by Mr. H. E. Yerbury. The author reviewed and criticised the Board of Trade Rules and Regulations and their revisions, from 1894 to the present date, and dealt with the influence of a leakage current on reinforced concrete. The preventive measures proposed by British and Continental authorities in order to reduce the potential differences between tramway tracks and pipes were classified, and a description of the function of a negative booster was given in detail. The author stated that where the rails and the mass of earth were positive to pipes in the vicinity of the track, there could be no danger to pipes in that area, as they were cathodic. On the other hand, danger existed to all pipes and metallic structures (where embedded in soil) which were positive to the rails, as it was the flow of current out of the pipes that had a tendency to cause corrosion and pitting. The danger, however, was nothing like as great as would appear from the theoretical standpoint. He pointed out that as current-density and duration of current were the most important factors in connection with injurious electrolytic action on gas or water pipes, potential readings were misleading; it was well known that where a comparatively high difference of potential existed, there was, as a rule, less injurious current passing. In his opinion, the Board of Trade regulations in respect of leakage currents could easily be complied with on all tramway undertakings, and were absolutely effective in safeguarding the property of other authorities. Up to 600 volts could be allowed between overhead conductors and earth, and this increase of voltage would reduce the cost of feeders and also the heavy currents now dealt with.

Society of Engineers (Inc.).—Mr. Sherard Cowper-Coles has been elected a vice-president of the Society, to fill a vacancy.

Manchester University.—In the course of a lecture on February 18th at the Manchester University, Mr. S. L. Pearce, chief engineer to the Manchester electricity department, remarked upon the increase in the supply of electricity in this country. In 1904, he said, there were 380 undertakings, producing 450 million units of energy for lighting and power purposes. In 1914 there were 502 undertakings, producing 1,636 million units. To be added to this, according to the latest returns, there were 586 million units supplied for tramway purposes, and 253 million units for the railways. The Manchester district had fully shared in this increase; in 1904 the output was 38 million units, with a maximum demand of 17,390 KW., and in 1914 it was 154 million units with a maximum demand of 50,000 KW.

S.A. Institute of Electrical Engineers.—The report for the past year shows that the income was £697, and the expenditure £426. The net surplus for the year was £137, and the credit balance amounted to £590, as against £454 a year ago. The membership was 236, compared with 278. In view of the unsettled times through which the country has passed, due to the strikes in 1913 and 1914, and to the war and rebellion, the Council regards the present position of the Institute as very satisfactory.

Royal Irish Academy.—In a paper read at a meeting of the Academy in Dublin, on "Some Electrical Properties in Thin Layers," Mr. A. J. McClelland pointed out that thin layers of such substances as graphite or bronze powder, formed on insulating materials, exhibited remarkable electrical properties. Although when newly prepared these layers might be almost non-conductors, when subjected for an instant to a strong electric field normal to the surface, and applied through the insulator, they became conducting. The paper dealt further with the laws obeyed by the conductivity, and discussed the difference between these effects and the coherer effect.

National Association of Colliery Managers.—In a paper on "A Year's Experience with the Miner's Electric Lamp," read before the NORTH STAFFORDSHIRE BRANCH at Stoke-on-Trent, Mr. Caleb Johnson said that when the lamps were first installed in the collieries difficulty arose in persuading the men, especially the older ones, to take kindly to them, the objection being the additional weight. That was soon overcome, however, and he was of opinion to-day that another pound in weight, or even more, might be added without objection from the miners, thereby giving facilities to increase the illuminating power of the lamp. The introduction of a lamp with greater illuminating power, in his opinion, tended to reduce the number of cases of miners' nystagmus. During 1913, at the colliery with which he was connected, they had a number of persons afflicted with the disease, but during the year 1914 they had none. They kept several spare lamps, and when they suspected a workman of suffering from, or developing, nystagmus, they gave him an electric lamp. Now they were receiving repeated testimony from the men that they could do their work in greater comfort, and read the newspaper at home in the evening without their eyes or heads aching in doing so.

Association of Mining Electrical Engineers.—At a meeting of the West of Scotland Branch held in the Royal Technical College, Glasgow, on February 20th, a paper was read by Mr. A. Smellie, New Cumnock, on "Experiences in Handling Colliery Electrical Plant." The author stated that when a new company was formed to work the New Cumnock collieries, it made arrangements for an installation of electrical plant for the pumping, coal cutting, haulage and auxiliary ventilation below ground, and for the driving of a washer on the surface. The plant consisted of two three-phase generators driven by steam impulse turbines with condensers, each capable of developing 1,000 KW. at 3,000 R.P.M., 3 000 volts, 50 cycles. The neutral was insulated. The generators were run alternately, as one was quite sufficient for the work. A big proportion of the current was used for pumping, which was carried out mainly by means of turbine pumps driven by three-phase squirrel-cage motors. Prior to the introduction of these the water was dealt with by every conceivable kind of pump. Breakdowns were numerous, and idle time was common, but since the installation of electric pumps not a single shift had been lost due to the breakdown of the pumping plant. While electricity had many advantages as a medium for operating haulages on long roads, it was as a motive power for auxiliary or face haulage that the writer thought it showed its greatest utility. Small electric haulages which were light in themselves, and were easily shifted about, could be cheaply installed. In an experience extending over a period of 10 years with small haulages, and some of fairly large size, he had not lost a shift due to the breakdown of electric fittings. In the pits at New Cumnock they had coal cutters working on all gradients up to 1 in 2 with complete success, and he would not have the slightest hesitation in applying them to even a greater inclination than that. There was no doubt about the efficiency and economy of a central generating station where a number of pits within a given radius had to be supplied with current, but those contemplating such an installation would be well advised to have nothing but plant of the very best construction. With machinery well designed, well housed, well supervised, and with cleanliness the dominating factor, repairs should be negligible and the measure of reliability equal to that of any machinery about a colliery. Changing from steam to electricity should be gone about slowly and regularly. If one motor after another was added by degrees, the men were trained as the system developed, while, on the other hand, if a dozen motors were dumped down at a time when the men were strange to the work, little things that would ultimately be considered of no consequence were regarded as mountains of difficulty, quite sufficient to prejudice many against the system.

At the meeting of the Notts. and Derbyshire Branch at Nottingham, on Saturday, a paper on "Typical Breakdowns in Colliery Electrical Plant, and their Prevention," was read by Mr. Llewellyn Foster.

Institution of Mechanical Engineers.—The annual report of the Council shows that the membership has increased from 6,346 in 1913 to 6,400 at the end of 1914. The total revenue for the year was £16,971, and the expenditure was £15,521. After deducting items credited to capital there remained a balance of £966. The capital of the Institution, less debentures and loans, &c., amounts to £69,273. The Benevolent Fund stands at £5,467.

Institution of Electrical Engineers.—At the meeting of the MANCHESTER LOCAL SECTION on Tuesday last, a paper was read by Mr. A. P. M. Fleming on "Training for the Industrial side of Engineering," and a discussion followed.

At the meeting of the YORKSHIRE LOCAL SECTION on Wednesday last a paper was read by Mr. C. P. Sparks on "Electricity Applied to Mining," and was followed by a discussion.

Appointments Vacant.—Mains assistant (35s.), for Radcliffe U.D.C.; switchboard attendant (30s.), for Portsmouth Corporation; sub-station attendant for Walsall electric supply department; assistant engineer, for Stafford electricity department; switchboard attendant, also wireman, for Blackpool Tower Co.; switchboard attendant (£1) for Heywood electricity works; switchboard attendant (32s.), for Borough of Bermondsey; works superintendent for West Ham Council (£250). Particulars are given in our advertisement pages.

Patents and Alien Enemies. — Letters Patent Nos. 10,859/01 and 24,439/02, granted to Goldschmidt for the Thermit process, have been avoided by the Board of Trade, on the application of Messrs. W. T. Turner and H. A. Blackwell. The hearing was reported in our issue for November 6th, 1914. In respect of Patent No. 7,995/02, granted to Jensen, Mr. G. Jones has been granted a licence.

London Electrical Workers.—The following paragraph appears in the *Herald* for February 20th:—

"Evidently the London members of the Electrical Trades' Union are not believers in the righteousness of being sweated for the sake of patriotism disguised as profit. The right to live under decent conditions and at fair rates is just as important, perhaps more so, now than in times of international peace, and London electrical workers realise this to the full. They are demanding an increase in wages to 1s. per hour and a 48-hour week from their bosses—and they will get it by force if need be."

(*Continued on page* 293.)

THE ELECTRICITY SUPPLY TO PORT GLASGOW FROM GREENOCK.

The history of the Greenock Corporation electricity department has been one continuous record of expansion, and the extension of the electricity supply into the neighbouring Burgh of Port Glasgow in November last is the logical outcome of the enlightened policy which has always distinguished this undertaking.

The department has been fortunate both in its chief engineers and in the Committees which have been entrusted with its management. They have endeavoured to maintain the price of electricity for power purposes at the lowest possible level, believing, quite rightly, that the interests of all classes of the community are better served by enabling engineers, shipbuilders and manufacturers successfully to compete for work, and so bring trade to the town, than by making large profits, which would only, at the best, take a half-penny or a penny off the rates.

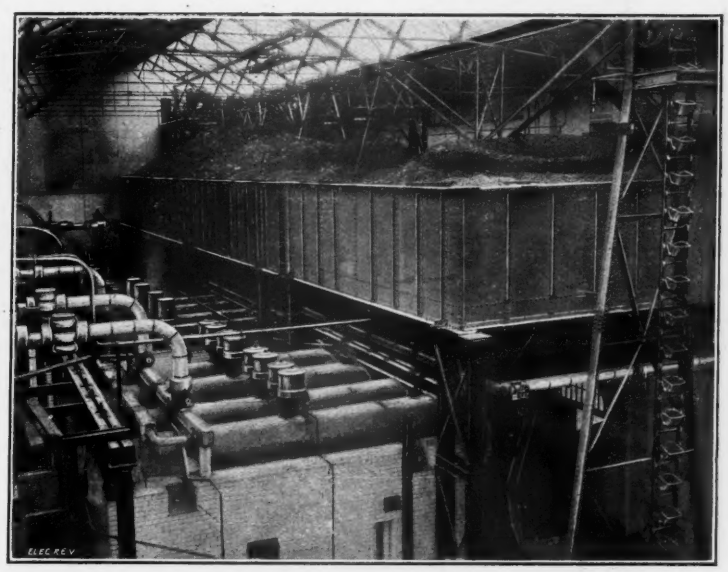


Fig. 1.—Dellingburn Power Station: Coal Bunkers and Conveyor.

The direct result has been that practically every power user in the town is a consumer, and last year the department sold 136 units per head of population, a figure exceeded by only one other undertaking in the United Kingdom.

The question of a supply of electricity to the Burgh of Port Glasgow had been raised several times during the last few years by the shipbuilders and engineers of that town, but their Council always put so many obstacles in the way that the project had to be dropped each time.

The cause of the disagreement between the two burghs is about a century old. In the days when the Clyde was only a shallow stream unfit for navigation, the City of Glasgow leased a tract of land on the lower reaches of the river, built harbours there, and called it Port Glasgow.

Greenock, a small fishing village three miles lower down the river, was better situated, and private enterprise under the patronage of the local Laird built larger and more commodious quays and harbours, and soon all the trade of Port Glasgow passed into the hands of its neighbour. Ever since then, the Town Council of Port Glasgow has been haunted by the fear of annexation by its larger neighbour, and all overtures from Greenock for the supply of water, gas, or electricity have been met with uncompromising obstruction.

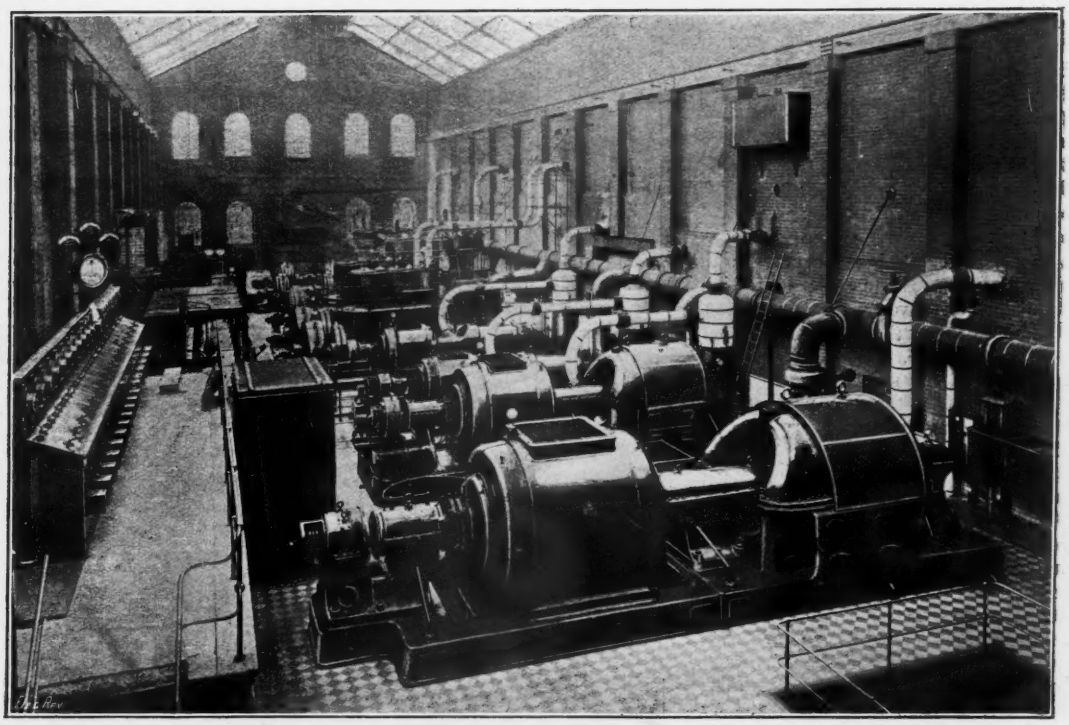


Fig. 2.—Engine Room, Dellingburn Power Station, Greenock.

Most of the shipbuilders in Port Glasgow had their own generating stations, but with the possibility of cheaper power being available from Greenock these had not been extended to cope with the increased demands of modern

shipyard work. The boom in shipbuilding recently brought matters to a crisis; a Committee of power users was formed,

Fig. 3.—Boiler House.

and as they were the largest ratepayers in the burgh, they were able to put pressure on their Council, and so the negotiations were brought to a successful conclusion.

Greenock has now taken over the Port Glasgow electric lighting order, and will supply Port Glasgow consumers on exactly the same terms as those offered to similar consumers in Greenock. In the event of a deficit, the Greenock Corporation may not levy rates in the Port Glasgow area, but to safeguard the department, the six principal shipbuilding firms in the burgh have signed a minimum guarantee and also an agreement to take all their electricity from Greenock for the next 29 years.

The town of Port Glasgow lies along the narrow strip of land between the River Clyde and the steep hills, which rise almost immediately from the water's edge. All the principal consumers have their shipyards in a line along the sea front, so that the problem of power distribution has been very much simplified.

With one exception, all the electrical plant of the various firms is suitable for a 250-volt supply, so that three 250-volt rotary sub-stations have been erected in the burgh, one at the Greenock boundary, one in the centre of the town and one on private premises at the far boundary.

The first two are public sub-stations operated by the electricity department, and supply both the town and the shipyards and engineering works lying between. A 1 sq. in. low-pressure, two-wire concentric trunk cable connects the two stations and loops into the principal shipyards, where links are provided so that each yard can be fed from either sub-station in the event of a fault occurring anywhere in the trunk cable.

At regular intervals along this trunk cable distributing pillars are installed, from which cables are run for the supply of smaller consumers. The system of distribution throughout Port Glasgow is two-wire.

The trunk cable between the sub-station in Bay Street (centre of town) and the sub-station in the Clyde Shipbuilding and Engineering Co.'s yard at the other boundary is 1 sq. in. up to Messrs. Ferguson Bros.' shipyard, and ·5 sq. in. thereafter. In addition to these three sub-stations there is a sub-station in Messrs. Wm. Hamilton and Co.'s yard. The reason for this separate supply is that Messrs. Hamilton's pressure for power is 420 volts.

The sub-stations are fed by two 10,500-volt E.H.T. three-core ·1 sq. in. cables which loop into alternate sub-stations, thus forming a high-tension ring main about 6½ miles long.

All the high-pressure feeders and low-pressure distributing mains for this extension were manufactured by Messrs. Callender's Cable and Construction Co., and the cables have been laid on both the solid and the draw-in systems.

The Boundary Street sub-station consists of two bays; in one are placed the switchgear and the rotaries, and the other is to be used as a battery room. The high-tension cubicles and all the switchgear in this station were provided by the British Thomson-Houston Co., Ltd., and the two 500-kw. rotary converters and transformers were supplied by the British Westinghouse Electric and Manufacturing Co., Ltd. The rotary converters are of the eight-pole compound-wound self-synchronising type, and are supplied with six-phase current at 185 volts, 50 periods. They have an overload capacity of 50 per cent. for three minutes, and the full-load efficiency for rotary and transformer is 92 per cent. The Bay Street sub-station is a duplicate of the Boundary Street sub-station as far as plant is concerned. In the Clyde Shipbuilding and Engineering Company's sub-station there is one 500-kw. rotary converter, and

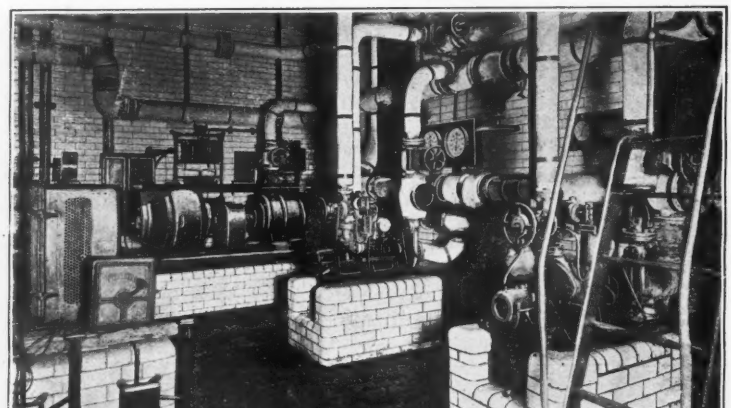


Fig. 4.—Pump House.

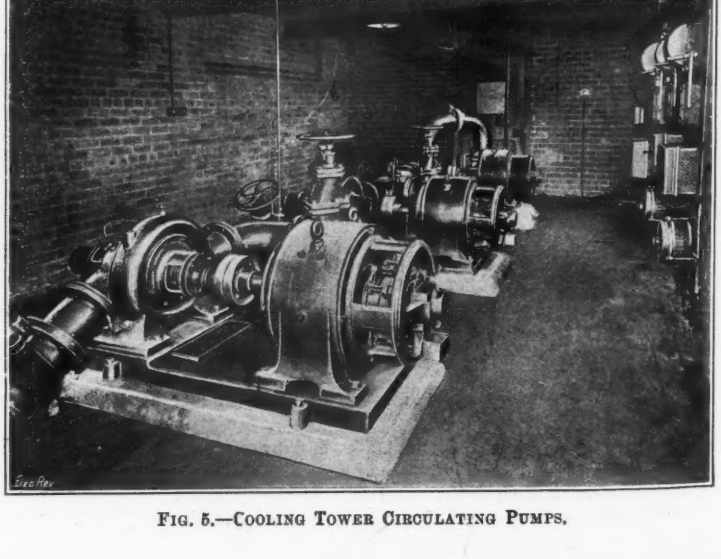


Fig. 5.—Cooling Tower Circulating Pumps.

the high-tension cubicles and switchgear, as well as the transformer and rotary converter, are of the British Westinghouse Co.'s manufacture. In Messrs. Wm. Hamilton

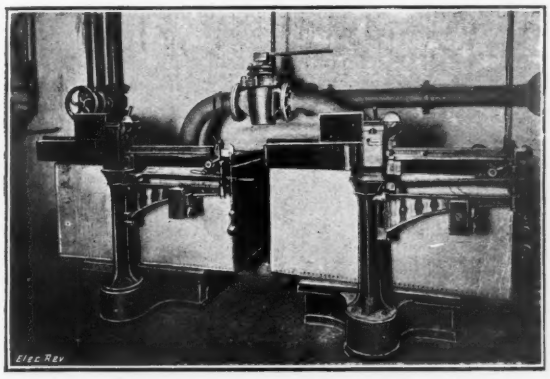


Fig. 6.—Testing Tanks.

and Co.'s sub-station there is one 500-kw. rotary converter, which, however, is wound for 420 volts, and is of the British Westinghouse self-synchronising type. The switchgear in this station is of the British Thomson-Houston Co.'s manufacture.

In all four sub-stations provision has been made for doubling the capacity of the plant now installed.

An extremely interesting collection of private generating plant has been displaced by the Corporation supply.

Messrs. Dunlop, Bremner & Co. had two modern steam-driven dynamo sets; these have been taken out and a 1 sq. in. concentric feeder from the Boundary Street sub-station now provides all the necessary power.

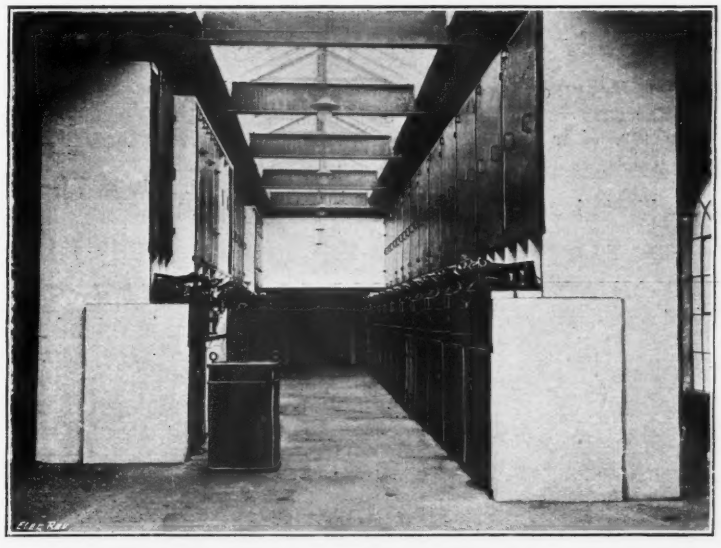


Fig. 7.—High-Pressure Switch Cubicles, Dellingburn Power Station.

Messrs. Russell & Co., shipbuilders, have two dockyards. Their Kingston Yard, which is opposite the Boundary Street sub-station, was supplied from three modern steam-driven dynamo sets; these have been sold, and the yard is fed by two 1 sq. in. concentric cables. In Messrs. Russell and Co.'s other yard, the original generating sets were two Crompton dynamos, driven by vertical gas engines. These engines gave a great deal of trouble to start, and were very often kept running on no load simply because of the difficulty of restarting. The Greenock Corporation latterly loaned the firm a large motor starter, so that the gas engine could be run up by motoring the dynamo. This yard is fed by two 1 sq. in., and one ·5 sq. in. concentric cables.

The Clyde Shipbuilding and Engineering Co. had the finest assortment of suction gas plant of any of the Port Glasgow shipbuilders. Their plant consisted of one 110-kw. compound dynamo by Messrs. J. P. Hall & Co., rope driven from a National gas engine; two 87·5-kw. compound dynamos by the British Westinghouse Co., rope driven from two Premier gas engines; and one 225-kw. compound dynamo by the British Westinghouse Co., direct driven at 160 r.p.m. by a Premier gas engine. The firm had also installed a 75-kw. dynamo by Messrs. Dick, Kerr & Co., driven by a Robey high-speed engine, so that the lighting of the works might be assured. A sub-station with a 500-kw. rotary converter has been erected on this firm's premises.

Messrs. Duncan & Co. have no generating plant of their own, but expect to take a minimum of 100 kw.

Messrs. Ferguson Bros., Ltd., shipbuilders and engineers, have two small gas engine sets which are fairly modern. Their demand also was estimated at a minimum of 100 kw., but owing to a recent fire which has completely destroyed their machine shops, they have intimated that an increased demand may be expected from them when the damage is made good.

Messrs. Wm. Hamilton & Co., shipbuilders, had a power plant consisting of a couple of two-pole low-speed sets sold out of Dickinson Street, Manchester, many years ago.

These and other superseded sets are illustrated on p. 292.

Messrs. Murdoch & Murray, shipbuilders, have also displaced a gas-engine set. They have not signed an exclusive use contract with the Corporation, but are taking energy for all power and lighting purposes at ordinary rates.

In addition to these eight shipyards and engineering works, the Kingston Investment Co., which bought up the slum area of the burgh and built model houses and shops, have displaced their own generating plant and have entered into an agreement with the department to take 50 kw.

The Caledonian Railway Co., who have just rebuilt their station at Port Glasgow, have adopted electric lighting and propose to use electricity for signal lighting also.

With all these exclusive use guarantees for 29 years, the extension of the electricity supply into Port Glasgow should prove a splendid venture for the Greenock electricity department, while it meets at the same time an undoubted need in the Port Glasgow area.

To cope with the demands of Port Glasgow, and also to meet the increasing load in Greenock, extensive alterations have recently been carried out at the generating station in Dellingburn Street. A switch annexe has been built

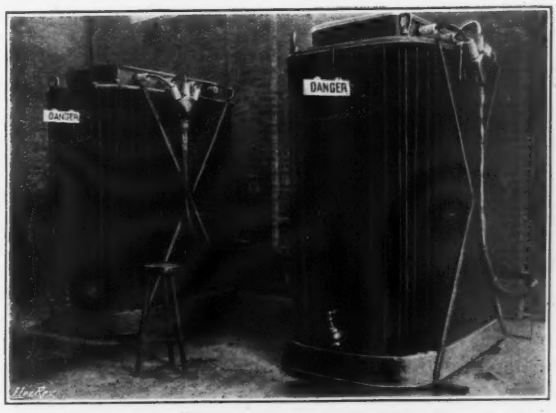


Fig. 8.—10,500-Volt Transformers.

at the end of the engine room with a complete equipment of Westinghouse cubicles and solenoid-operated remote-control switchgear to operate the high-pressure alternators and

feeders. These displace the existing high-pressure switch-gear in the engine room, and their place is now occupied by a control desk.

Two 1,000-KVA. Westinghouse oil-insulated self-cooling transformers, with a ratio of 3,300 to 10,500 volts, are used to step up the station voltage for the Port Glasgow supply. Under normal conditions one transformer is used on each feeder, but the switching arrangement is such that one transformer can be used on both feeders, or two transformers can be used on one feeder.

Owing to the heavy load which has already been connected in Port Glasgow, two more 1,000-KVA. transformers, duplicates of the original pair, are now on order, so that two transformers in parallel may be permanently connected on to each feeder. The switches controlling these feeders are hand operated.

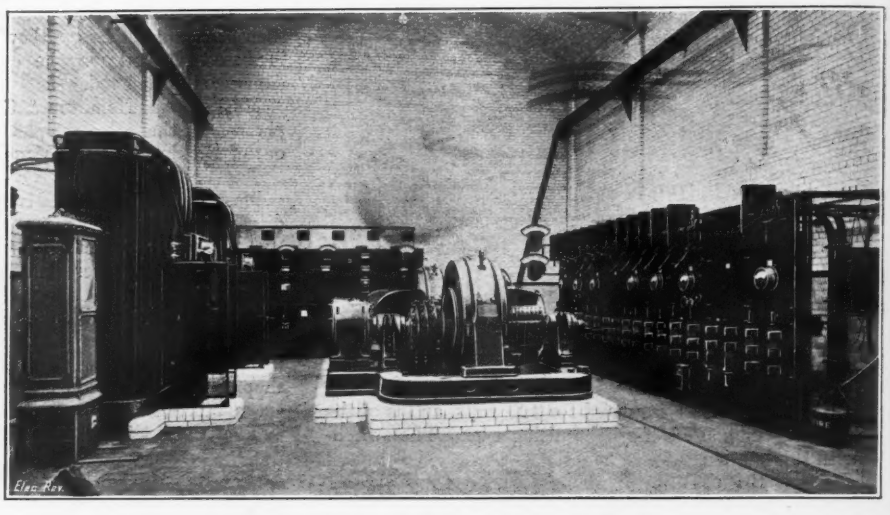


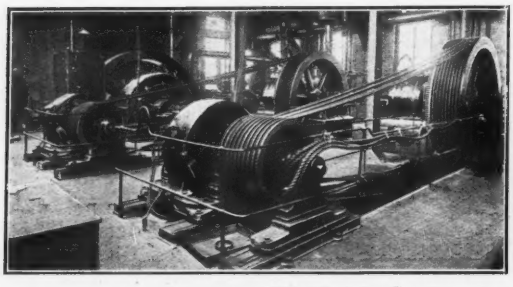
FIG. 9.—BAY STREET SUB-STATION, PORT GLASGOW.

A turbo-alternator set of 5,000 KW. capacity has also been installed, thus bringing the total plant capacity of the power station up to 11,300 KW. (four turbo-alternators totalling 9,000 KW. and four reciprocating D.C. sets totalling 2,300 KW.).

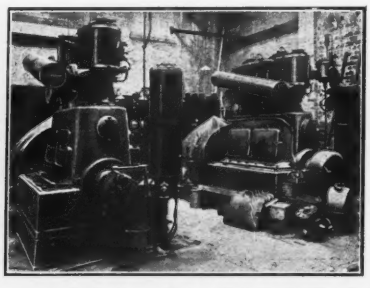
This last set consists of a Westinghouse Rateau impulse turbine running at 1,500 R.P.M. and driving a 3,300-volt, 50-cycle alternator of the compensated type. A Sturtevant wet air filter is provided, and the condenser is operated by a turbine-driven air pump of the Le Blanc type.

Further converting plant has been provided by separating a 750-KW. motor-generator set, which consisted of two 250-volt and one 500-volt D.C. machines coupled together on the same bedplate and used as a motor balancer. Instead of the 500-volt machine, a 3,300-volt 750-KW. induction motor has been connected to the two 250-volt machines, thus providing 750 KW. of converting plant in the main power station, which can be used as a balancer; the 500-volt machine has been coupled to another 3,300-volt 750-KW. induction motor, and the set has been installed in the original Hunter Place station, which is now used entirely as a sub-station. In addition to this 750-KW. motor-generator, there are in this sub-station two 500-KW.-volt Westinghouse rotary converters and transformers.

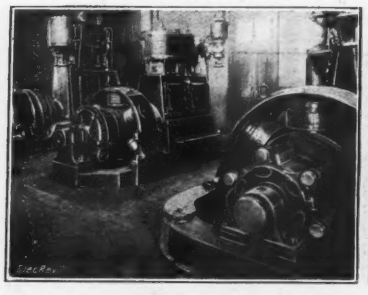
Two 18,000-lb. Babcock & Wilcox boilers have been added, bringing the total number of boilers up to 12, including the three destructor boilers, and the overhead coal bunkers and conveyor have been extended to include these additional boilers. To make room for a large economiser to meet the requirements of the increased plant, the original pump room at the end of the boiler house has been removed and a new pump room has been erected. The pumping plant consists of one 7,000-gallon Rees Roturbo rotary pump, one 10,000-gallon and one 4,000-gallon Weir double-acting vertical pumps, one 10,000-gallon and one 7,000-gallon Weir latest type rotor feed pumps. Above the pump room is situated the Paterson oil-eliminating plant, while in the basement below the pump room are placed the two hot wells, one for turbines and one for reciprocating plant. In the basement is also located the apparatus for measuring the condensed water from any one of the generating sets in the station. Two large



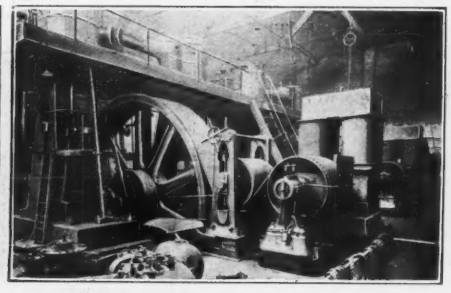
Gas-driven Plant of the Clyde Shipbuilding and Engineering Co., Ltd.



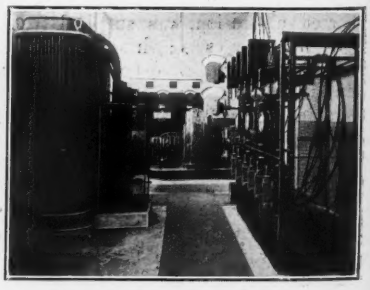
Steam Plant of Messrs. Dunlop, Bremner and Co.



Messrs. Russell & Co.'s Plant at Kingston Yard.



Old Friends at Messrs. Wm. Hamilton & Co.'s Works.



Sub-Station at Messrs. Hamilton & Co.'s Works.

FIGS. 10—14.—SOME EXAMPLES OF PLANT SUPERSEDED BY THE CORPORATION SUPPLY; AND ONE OF THE NEW SUB-STATIONS.

tanks are mounted on Avery weighing machines, and the condensed waterpipe is made to terminate above and between these tanks. A two-way cock and tee-pipe are fitted by which the water can be directed into either tank. When a generating set is to be tested, the condensed water from the set is directed by means of selector valves into the pipe connected to the tanks. When one tank is filled, the weighing machine is balanced, and the weight is then automatically stamped on a card, after which the tank is emptied by a valve in the bottom. Meanwhile, the next tank is filling, and the process is repeated continuously during the period of test. The load on the machine is kept fairly constant, and the units generated during the test are noted, and the consumption per KW.-hour at that load is thus easily obtained. The performance of each generator is checked in this manner at frequent intervals.

Two Lea recorders have been installed. One records the total boiler feed, while the other is connected in circuit with the 5,000-KW. turbo-alternator set.

A Sanders Rehders steam meter is installed to record the steam delivered from the refuse destructor boilers, and the British Thomson-Houston Co.'s steam meters are to be fitted to several of the boilers.

Although Greenock is favoured with a remarkably good power load, the possibilities of the domestic load have not been neglected. Energy for heating and cooking purposes is sold at a flat rate of $\frac{3}{4}$d. per unit if metered separately, but where this is not possible an "annual charge" tariff may be adopted by which the consumer pays a fixed sum per quarter based on the lighting maximum demand, and all units registered by meter for both lighting and heating purposes are charged at $\frac{3}{4}$d. per unit.

Over a year ago, the Corporation opened large showrooms in the main thoroughfare for the use of its hiring and publicity section. This department was inaugurated in 1904 for the hiring of lighting installations and motors, and already 383 lighting installations and 160 motors have been fitted up on this system. Lately, the scheme was extended to include cookers, &c., and of these the department has installed 56 cookers, 162 radiators, and 186 irons, kettles, &c. As showing the necessity for the Corporation's policy of providing facilities for hiring electrical appliances, it may be pointed out that out of the total of 1,650 consumers on the mains, no fewer than 453 have been introduced to the undertaking through this hire and hire-purchase department, and these represent a demand of over 1,700 KW. distributed among houses, shops, factories, and workshops.

As an indication of what can be done in developing the heating load when tariffs are favourable, it is only necessary to mention that during the three months ended December 31st, 1914, the department sent out on the hire-purchase system 58 radiators, 19 irons, and 11 kettles, making a total increase in the connections to existing services of 103 KW.

The development of the undertaking during the 15 years of its existence is shown in the following table, which gives the data for the fifth, tenth and fifteenth years of operation :—

	1903-04.	1908-09.	1913-14.
Units sold	1,413,783	3,495,852	11,451,438
Average price obtained per unit	2·00	1·45	1·04
Total cost per unit, pence ...	1·25	·825	·610

Mr. J. A. Robertson, the late engineer (now borough electrical engineer of Salford) was responsible for the Port Glasgow extension scheme, and the new engineer, Mr. Frank H. Whysall, has put the scheme into operation on the lines planned by his predecessor.

Owing to the large amount of Admiralty work carried out in Greenock, the demand for power has risen to such an extent that further extensions are urgently required. These include a new 5,000-KW. turbo-alternator set, the erection and equipment of a rotary converter sub-station in the east end of the town to relieve the overloaded feeders in that district, the installation of another 500-KW. rotary converter in Messrs. Scott's Engine Works sub-station, the laying down of a new 0·6 sq. in. feeder to the centre of the town, and the erection of large economisers and flues at the power station.

We are indebted to Mr. Frank H. Whysall, M.I.E.E., for the foregoing information regarding the undertaking, and to Mr. John H. Parker, his chief assistant, for the photographs with which this article is illustrated.

NOTES.

(*Continued from page* 288.)

Parliamentary.—*London County Council's Tramways Bill*.—The Select Committee on Standing Orders have agreed that the London County Council Tramways and Improvements Bill be allowed to proceed on condition that Tramways Nos. 3 and 3A are struck out of the Bill.

London Electric Supply (No. 2) Bill.—On the motion for private business in the House of Commons on Monday night, the Chairman of Ways and Means on the London Electric Supply Bill said :—After carefully considering the nature and scope of the powers which are sought in this Bill, I have informed the promoters that in my opinion the Bill is not one which the House ought, in the present Session, to be called upon to consider, raising, as it undoubtedly does, important questions of a public character and contentious nature. The promoters have therefore agreed that the order for the Second Reading of the Bill shall be discharged and the Bill withdrawn. The question was put and agreed to.

Second Readings.—In the House of Commons on Tuesday, the Metropolitan District Railway Bill was read a second time, as was also Rhondda U.D.C. (Tramways Extensions, &c.) Bill.

In the House of Lords, the Mersey Railway Bill, the Yorkshire Electric Power Bill, and Ormskirk Gas and Electricity Bill were read a second time.

Standing Orders.—The Standing Orders Committee having considered the Aberdare U.D.C. Tramways Bill and the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board Bill, which were reported for non-compliance with Standing Orders, have decided that the Bills may be allowed to proceed. They have also allowed the Halifax Corporation Bill to proceed on condition that Tramways Nos. 4, 5, 6, 7 and 21 are struck out.

Petitions.—In addition to the petitions deposited in the House of Commons, the following, amongst others, are lodged in respect of Bills emanating in the House of Lords :—Yorkshire Electric Power, 25 petitions including a number of local authorities and gas companies ; Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board 12 petitions, including the Lancashire Electric Power Co., Derbyshire and Cheshire County Councils, &c. ; Aberdare U.D.C. Tramways by the Great Western and Taff Vale Railway Co. ; Ormskirk Gas and Electricity by the Lathom and Burscough U.D.C.

A Letter from the Front.—The Chairman of the Epsom Urban Council (Councillor C. Cropley) has received a letter from Mr. A. C. Gilling, the electrical engineer of Epsom, who is at the Front with the Westminsters. The letter reads :—"Life out here is not quite such a holiday as Egypt or India would have been, but I would not have missed the experience for worlds. We spend about four days and four nights in the first line, and then we go into the reserve for a few days. You would not recognise me if you saw me. We wear two pairs of socks, two pairs of putties, one ordinary uniform, a fur coat over all, and, lastly, inches of mud. I am writing this in what we call a 'bug-hutch.' It is a nice little hole dug in the ground, in which three of us live and sleep, and at the time of writing the enemy is taking pot shots at anyone who shows his head for a moment above the trench. One of our greatest amusements is considering how to devise a new way of cooking bully beef and making tea. Life is pretty strenuous. I have not had my boots or clothes off for three weeks, and I am getting quite used to sleeping on the ground—concrete floor. Our best fun is at night on guard. We wait for the flashes from the German rifles, and then fire back from where they come. The only unfortunate thing is, we don't know if we hit the mark."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Last week the Middlesbrough Electricity Committee, according to a Yorkshire paper, consented to release the borough electrical engineer, MR. H. M. TAYLOR, who intended offering his services to His Majesty's Forces.

The staff of the Stamford electricity works have presented a hall clock to MR. W. WELLS, meter inspector, on his marriage ; the gift was handed to Mr. Wells by the resident manager of the Urban Electricity Supply Co., Lieut. F. H. Brandreth.

MR. WILLIAM MAWBY, a member of the staff of the Blackburn Corporation electricity department, was married at Blackpool on Monday to Miss Mary A. Frankland, of Blackpool. Mr. Mawby's colleagues at Blackburn have presented him with a mahogany timepiece.

We are glad to hear that MR. C. CLARE ATCHISON, the Rochdale borough electrical engineer, who has undergone an operation, is improving.

MR. J. W. A. DEVOY has resigned his position as mains superintendent to the Tunbridge Wells Corporation electricity department.

Tynemouth Corporation has been recommended to increase the salaries of the following officials in the electricity department as from April 1st next:—Mr. C. Turnbull, jun., electrical engineer, from £300 to £325 per annum; Mr. J. Waller, engineer, from £3 to £3 5s. per week; Mr. H. T. Wilkins, chief clerk, from £2 to £2 5s. per week.

Mr. A. J. Seward having resigned his appointment as constructional lighting superintendent at the West Ham electricity works, Mr. J. Turtle, the assistant, has been appointed to fill the vacancy at a salary of £156 per year, plus commission. The Electricity Committee proposes to grant the following increases in the salaries of the undermentioned employés:—Mr. H. Irons, installation inspector, Mr. G. Hale, constructional assistant, Mr. W. Whitney, assistant mains engineer, from £215 to £240 per annum; Mr. J. C. Retzbach, assistant draughtsman.

Upon consideration of a recommendation by the Electricity and Tramways Committee of the Bingley District Council that the salary of the electrical engineer should be increased by £20 per annum, the Council referred the matter back.

Mr. J. B. Patterson, at present works superintendent at Lancaster electricity works, has been appointed assistant engineer while Lieut. G. C. Milner (engineer) is on active service at the Front. Councillor Heald (chairman of the Committee) said the appointment was well merited; and he complimented one of the works employés, Mr. W. Corless, on having returned to the Colours with five sons.

Tramway Officials.—Mr. Charles Henry Hoggard, who has for 17 years been associated with the Sheffield tramways, has been appointed traffic superintendent of the Darlington municipal tramways.

Mr. R. L. McCulloch, manager of the Warwick and Leamington Tramway and Lighting Co., has been appointed general manager of the City of Carlisle Electric Tramways.

Mr. L. Johnson, manager of the tramways at Southampton, has resigned.

The Tramways Committee of the Huddersfield Town Council have granted the following increases of salary:—Mr. A. P. Quilliam, assistant tramway engineer, from £170 to £180; Mr. T. Hartley, traffic superintendent, from £150 to £160.

General.—Mr. T. P. Brogan has been appointed chairman of the Battersea Electricity Committee for the ensuing three months.

Mr. C. C. T. Eastgate, M.I.E.E., has been appointed Electrical Inspector to the Government of the Punjab, and sails for India on the 6th prox.

Obituary.—Mr. R. H. Claxton.—It is with much regret that we have to record the death on the 18th inst. of Mr. Robert Heywood Claxton, one of the most prominent pioneers of the telephone system in this country. Born in Liverpool in 1840, it was in Liverpool also that Mr. Claxton's telephonic activities commenced in 1879. In 1905 he retired from the position of provincial superintendent of the National Co.'s north-western province, and was elected to a local directorship, which position he continued to occupy until the taking over of the National Co.'s system by the Government at the end of 1911. It was in New Brighton, near Liverpool, that Mr. Claxton passed away. He was remarkable for a prompt recognition of the peculiarities of the Telephone Exchange business, and its combination of commercial and engineering problems. Though claiming no technical qualifications, he had exceptional judgment in the selection of his engineering advisers, the earliest of whom was Mr. Haworth, and amongst others we may recall the late Mr. Hope-Jones, Mr. France, and Mr. Gill, all of whom served under Mr. Claxton. It is perhaps for this reason that Liverpool was prompt to adopt new developments in the art. On October 18th, 1884 (Electrical Review, Vol. XV, page 312), we recorded the introduction of the multiple switchboard at Liverpool, and the first use in the United Kingdom of dry core cable was made in Mr. Claxton's district in the Mersey Tunnel. He was the first to employ lady operators, and with such success as to lead to his assistance being sought to organise a similar staff in London. His relations with his subscribers and the local authorities were of the best, and in the competitive era Liverpool was immune from competition. With his colleagues and business friends he was always cordial and courteous, and regret at his death will be general and widespread.

Lance-Corporal J. A. Donald.—We regret to learn of the death, at the age of 24 years, of Lance-Corporal J. A. Donald, of the Royal Naval Division (Engineers' Section), who died suddenly from myocarditis whilst on leave on Sunday last. He was for several years on the electricity works staff of the Blackpool Corporation, and we have it on the best authority that he gave promise of a very brilliant career. He was a most successful student at the Harris Institute, Preston, having taken the bronze medal and many certificates in electrical and mechanical engineering. He had also been a student of the Institution of Electrical Engineers since 1911. Lance-Corporal Donald, along with two other members of the Blackpool staff, joined the R.N.D. of the Institution of Electrical Engineers in September.

Mr. F. W. Farmer.—The death is announced of Mr. Frederick William Farmer, for many years engineer at the Weymouth electricity works.

Mr. J. W. Proctor.—The death has taken place, in his 55th year, of Mr. Jas. Wm. Proctor, of the firm of Jas. Proctor, Ltd., mechanical stoker makers, of Burnley.

Mr. G. Matthews.—The sudden death is announced of Mr. George Matthews, for many years manager of the carriage department of the Bristol Tramways and Carriage Co., Ltd. He was in his 73rd year.

Mr. William Long, of Thelwall Heys, Grappenhall, near Warrington, and Cleabarrow, Windermere, whose death is announced at the age of 80 years, was a director of the Windermere and District Electricity Supply Co., Ltd., and was first chairman of the company.

The death has occurred, in his 36th year, of Mr. Michael Traynor, of Bray, Co. Wicklow, chairman of the Urban District Council's Electric Lighting Committee.

NEW COMPANIES REGISTERED.

M-L. Magneto Syndicate, Ltd. (139,152).—This company was registered on January 28th, with a capital of £15,000 in £1 shares, to carry on the business of manufacturers of, and dealers in, apparatus, machinery, instruments and fittings used in connection with the generation, distribution, supply, accumulation and employment of electricity, general electrical engineers and electricians. The subscribers (with one share each) are:—D. H. Morris, 14, Waverley Road, Kenilworth, electrical engineer; G. A. Lister, 23, Coundon Road, Coventry, electrical engineer. Private company. The number of directors is not to be less than two or more than six; the first are C. A. Lister, D. K. Morris, G. A. Lister and E. A. Watson. So long as R. A. Lister & Co., Ltd., hold the majority of the shares, they may appoint two other directors; remuneration as fixed by the company. Registered office, Carlton Works, Lockhurst Lane, Coventry.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Foster Engineering Co., Ltd.—A memorandum of satisfaction to the extent of £4,000 on February 10th, 1915, of second debs., dated August 1st, 1913, securing £9,000, has been filed.

Wellingborough Electric Supply Co., Ltd.—Issue on February 12th, 1915, of £2,700 debs., part of a series of which particulars have already been filed.

Sun Electrical Co., Ltd.—A memorandum of satisfaction to the extent of £375 on February 9th, 1915, of deb. stock dated March 31st, 1911, securing £7,000, has been filed.

Sheerness and District Electric Power and Traction Co., Ltd.—Issue on February 12th, 1915, of £1,000 6 per cent. second debs., part of a series of which particulars have already been filed.

Bombay Electric Supply and Tramways Co., Ltd.—Issue on January 1st, 1915, of £10,000 debentures, part of a series of which particulars have already been filed.

Holophane, Ltd.—Capital, £200,000 in £1 shares (100,000 pref.) Return dated November 13th, 1914; 60,732 pref. and 92,485 ord. shares taken up; £15,207 paid; £137,960 considered as paid. Mortgages and charges, nil.

Mond Nickel Co., Ltd.—Particulars of £500,000 6 per cent. redeemable debenture stock, created November 17th, 1914, and secured by trust deed dated February 10th, 1915, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, except uncalled capital, subject to £375,000 1st mortgage deb. stock. Trustees: Rt. Hon. Earl of Selborne, K.G., G.C.M.G., and R. Armitage, M.P.

Costa Rica Electric Light and Traction Co., Ltd.—Capital, £130,000 in £1 shares. Return dated January 6th, 1915. All shares taken up. £7 paid. £129,993 considered as paid. Mortgages and charges: £286,650.

John Spencer, Ltd.—Capital, £75,000 in £5 shares (10,000 pref.)—Return dated December 8th, 1914. 10,000 pref. and 1,027 ord. shares taken up. £55,135 considered as paid. Mortgages and charges: £25,000.

Cordoba Light, Power and Traction Co., Ltd.—Capital, £1,000,000 in £1 shares (300,000 pref., 600,000 ord. and 100,000 unclassified). Return dated December 23rd, 1914. 300,000 pref. and 600,000 ord. shares taken up. £1 per share called up on 300,000 pref. and 170,100 ord. shares. £470,100 paid. £429,900 considered as paid on the remainder. Mortgages and charges: £894,000.

CITY NOTES.

Kensington and Knightsbridge Electric Lighting Co., Ltd.

During the year 1914 the number of houses and shops connected with the system increased by 124, from 4,817 to 4941, and the energy consuming devices, calculated as represented by lamps of 30 watts consumption, by 6,528 to 488,912 (14,600 kw.). The net profit available for dividend is £14,020, plus £2,558 brought forward.

Deducting the interim dividends on the ordinary and preference shares, £7,575, there remains £9,004.

The second half-year's dividend on the first preference shares absorbs £1,500, and the dividend on the second preference shares from the 1st October to 31st December, £625. A dividend at the rate of 10 per cent. per annum for the last half-year (£5,250) making 9 per cent. for the year on the ordinary shares is recommended, carrying forward £1,629.

The renewal and reserve fund account has been increased by the transfer of £9,746, and now stands at £131,884, of which sum £93,454 is the amount expended in excess of capital received, the balance being represented by working capital, investments, and cash balances. The directors announce the resignation of Mr. R. W. Wallace, K.C., who had been a director since the formation of the company. They have elected Mr. H. W. Miller, who has been associated with the company from its commencement, to the vacancy. Mr. Miller has been appointed managing director.

Annual meeting, March 4th.

Underground Electric Railways Co. of London.

The report shows that for the year ended December, 1914, the net revenue from investments and properties (including general interest), after deducting general expenses, amounted to £673,830. The service of the 4½ per cent. bonds of 1933, required £89,349, and of the 4½ three year secured notes from 30th April to 31st December, required £21,085, leaving a surplus of £563,396. Payment under the guarantee on Central London Railway Company Assented Stocks for the year absorbs £37,031; six per cent. per annum on £1,273,000 six per cent. first cum. income debenture stock for the year, requires £76,380; six per cent. per annum plus income tax on £6,330,050 six per cent. income bonds of 1948, for the year, absorbs £411,544, leaving £38,442. The income from investments and other sources amounted to £684,626, an increase of £54,809 or 8.70 per cent.

The passenger earnings of some of the companies have been adversely affected by the conditions prevailing in London since the commencement of the war, and there has been an increase in expenses due to increased wages and cost of material. As a result, the revenue from these companies is less than that for the corresponding period in the previous year.

Before the war began the London Electric Railway and City and South London Railway Companies were well forward with their preparations for proceeding with the extensions and improvements involving large capital expenditure. As the conditions of the money market were then not favourable to capital issues by these companies, this company bought from them £463,000 and £412,000 of their respective debenture stocks, and issued £700,000 of its own 4½ per cent. three-year notes secured on these debenture stocks.

During the year this company acquired all the issued shares and debentures of the Metropolitan Steam Omnibus Co., Ltd., which subsequently sold its assets to the London General Omnibus Co., and was wound up. At the same time the Underground Co. sold to the L.G.O. Co. the assets which it had purchased in the previous year from the New Central Omnibus Co., Ltd., and this company has also been wound up.

The northern extension of the London Electric Railway, from Paddington to the Queen's Park Station of the London and North Western Railway, was opened for public traffic on January 11th, 1915, as far as Kilburn Park Station, and on February 11th, 1915, to Queen's Park station. The intermediate station at Maida Vale will not be opened until April next.

Additional omnibuses were added to the fleet of the L.G.O. Co. and new garages built in the early part of the year under review, but the total number of omnibuses in service and garages in use has been substantially reduced by the requirements of the War Office and Admiralty.

The Associated Equipment Company is making additions to its factory and equipment which will afford facilities for a much larger output.

The balance of £45,170 on revenue account on December 31st, 1913, has, in consequence of the changes in the constitution of the company, been applied in reduction of the item "Commission and discount of issue of bonds." The item of stocks and shares stands in the books at £14,520,892.

Passengers carried and passenger receipts earned by Associated Companies:—

	1912.	1913.	1914.
Metropolitan District—			
Passengers	86,003,149	89,438,332	*
Receipts	£652,670	£686,177	*
London Electric—			
Passengers	100,882,586	100,263,755	101,074,981
Receipts	£713,629	£709,872	£707,393
Central London—			
Passengers	—	37,505,424	36,702,836
Receipts	—	£250,257	£240,029
City & South London—			
Passengers	—	22,723,856	23,847,930
Receipts	—	£145,652	£136,128
London & General Omnibus—			
Passengers	487,201,629	580,205,335	569,343,223
Receipts	£2,684,329	£3,191,205	£3,132,259
Total—			
Passengers	674,087,364	830,136,702	*
Receipts	£4,050,628	£4,983,163	*

* Figures not available—Metropolitan District Railway, under Government control from August 4th, 1914.

Annual meeting, March 4th.

Metropolitan Railway Co.

The report submitted at yesterday's annual meeting, after referring to the Government control of the system since the war and the basis agreed upon with the companies, showed that the gross receipts in respect of the railway, etc., were £969,982, and the expenditure was £553,139, leaving £416,783, plus £181,503, miscellaneous receipts (net) from rents, interest, brought forward. Deducting interest, rentals and other fixed charges, and appropriation to renewals, £302,788, and dividends on preference stocks, £211,482, the balance available for dividend on ordinary stock is £92,274.

The dividend is £1 5s. for the year, with £11,458 carried forward, and £12,500 transferred to the general renewals fund.

The dividends for 1913 was £1 12s. 6d. per cent., and £8,258 was carried forward. The dividend on the surplus lands stock is £2 15s. per cent., the same as for 1913.

The electrical sub-station at Drayton Park has been completed, and the current for working the G.N. and City section has been supplied from the company's generating station at Neasden since 24th September last with satisfactory results. In April last new stations were opened at Goldhawk Road and Uxbridge Road on the Hammersmith and City line, which have taken the place of the old Shepherd's Bush Station, now closed. Escalators have been put in at Baker Street Station at the joint expense of this company and the London Electric Company to improve the means of exchange between the Metropolitan and Bakerloo systems. Owing to the situation created by the war, delay has taken place in the commencement of the building of the hotel at Baker Street. The completion of the widening of the railway between Finchley Road and Wembley Park has been delayed mainly in consequence of the scarcity of labour arising out of the war, but it is expected that the section at present unfinished, namely, the viaduct at Kilburn, will be completed and brought into use in the course of the next few months.

The company is not promoting any Bill in the present session of Parliament.

Having regard to the large amount standing to the debit of capital account, the directors availed themselves of a favourable opportunity to issue £500,000 £5 per cent. preference stock in December last. The stock is being paid for by instalments, and a substantial proportion has been pre-paid.

Four hundred and thirty of the employés of the company have joined His Majesty's Forces, and many of them are now serving abroad.

Central London Railway Co.

Lord George Hamilton presided on February 18th at the annual meeting, held at the Westminster Palace Hotel. He said that owing to the war, the gross receipts were £10,146 less than in the previous year. The car mileage had decreased by 466,591 miles, or about 7 per cent. The passenger receipts per car mile were 9.390d., compared with 9.099d. for the corresponding period. The percentage of operating expenses to traffic receipts was 59.67, as compared with 58.47 for the preceding year. The balance available for dividends was £115,762, which was £16,716 less than for the corresponding period. This year they paid ¾ per cent. less on the ordinary stock, and ¾ per cent. less on the deferred ordinary stock. Even with those reductions in dividend the balance which they carried forward of £15,413 was £5,465 less than the balance of the preceding year. Looking, therefore, to the future, to the almost certain increased cost of coal, and the various other charges that might be put upon the company, they thought it undesirable to further reduce the balance, and he thought, considering the uncertainty which attended the future traffic of underground railways in London, the shareholders would agree in thinking that the directors exercised a judicious discretion in thus curtailing the dividend. They had also considered it expedient to postpone embarking in new contracts, and thus certain extensions and improvements, such as the widening of the tunnels at Holborn, and the installation of escalators at Shepherds Bush, Oxford Circus and the Bank, were postponed. The Wood Lane extension, which would connect the line with Ealing, had been advanced, but owing to the war the progress had not been very rapid. As regarded the future receipts and progress of the company he wished to speak with all caution. The property was in most excellent order, and the extension which would shortly be made to Ealing would, he thought, give it additional attraction. On the other hand, it did suffer considerably from competition with the motor-'buses, for their track lay parallel with it almost throughout the whole of its route. Their experience in the past was that in fine weather passengers preferred for short journeys the motor omnibus, while for more lengthy travel they had recourse to the tube railways, and therefore every extension such as that which was about to be completed to Ealing would add to the receipts of the railway.

Earl St. Aldwyn seconded the motion, which was carried unanimously.

Metropolitan District Railway Co.

Lord George Hamilton, G.C.S.I., presided, on February 18th, over the annual meeting. He said that in common with other railways they had felt the effects of the war. The Government had taken over the control of the railways from the outbreak of hostilities, and they arranged to pay the companies the net revenue which they obtained in 1913, subject to the condition that if such receipts in the first half of 1914 proved to be less than the amount received in the corresponding period of 1913, the compensation payable to the companies should be reduced proportionately. That principle had somewhat adversely affected those companies whose receipts in the first half of 1914 were higher than those in the corresponding period. They had a balance available for dividend on the second preference stock of £43,288. Upon that stock they last year paid a dividend of 2½ per cent. for the whole year. They came to the conclusion, after careful consideration, that this year it would not be desirable to pay more than a 2 per cent. dividend for the whole year. 1½ per cent. had been paid in the half year ending 30th June, 1914, and they proposed to pay ½ per cent. for the second half year and to carry forward a balance of £13,888. They could, out of the balance, have paid another ½ per cent. dividend, but they came to the conclusion—looking at the probable rise in the price of coal and other supplies—that it would be desirable to carry forward a good balance. As regarded capital expenditure, they deter-

mined to postpone all new contracts that were not absolutely necessary or in connection with which agreements had not been entered into. Certain of the stations had been materially improved: Charing Cross was now connected by escalators with two of the underground railways, and he was glad to say that the improvements there effected were thoroughly appreciated by the public, and were bringing them a substantial increase in receipts. Structural alterations had been made at Blackfriars Station, and the flying junction works at Earls Court had been completed and opened for traffic, and additional rolling stock had been delivered and placed in operation. The capital expenditure during the year had amounted to £117,399, the main items being £12,194 expended upon the flying junction at Earl's Court, and £77,215 on rolling stock. Estimated further capital expenditure amounted to £60,000, of which £25,000 was required for miscellaneous items. Since the outbreak of war, a very considerable number of the officers and staff of all the companies who were working in connection with the Underground were summoned or enlisted for war service. He was proud to think that the Underground group supplied a large number of men in answer to this call. In reviewing the past year, there was one incident which gave special satisfaction to everybody connected with his railway. It was the honour of knighthood which was conferred upon their popular and competent managing director. Sir Albert Stanley's connection with the Metropolitan District had been one of continuous progress. He had the knack of making himself as popular with the employés under his control as with the general managers of other companies, and he thought it was universally felt that no more appropriate selection for distinction of the Sovereign could have been made from the high officials of railway management. His review of the incidents connected with this railway during the past year was necessarily bald and jejune, but he and the other directors had unabated confidence as regarded the future prosperity of the line when peace and quietude were restored, and although its development might be slow there was every indication that it would be both certain and continuous.

Sir Charles Dalrymple, Bt., seconded the motion, and the report was adopted.

London Electric Railway Co.

The annual meeting was held on February 18th at the Westminster Palace Hotel. Lord Farrer, who presided, said that the railway did not come under Government control, but during mobilization complete freedom of transport was given to soldiers and sailors. Having referred to the arrangements made to pay certain salaries to the officers and clerical staff engaged on war service, and congratulated Sir Albert Stanley on his knighthood, his lordship proceeded to refer to the progress of the various works sanctioned at previous meetings. The Charing Cross extension, opened in April, was familiar to all Londoners, and even with the abnormal conditions which had prevailed during the last six months, was showing good results. The Queen's Park extension, already under construction to link up the Charing Cross railway with Watford, was opened—as far as that company was concerned—last month, as part of their original scheme, and they hoped in normal times would develop a satisfactory traffic. These and other works were part of a well-considered plan for developing the traffic of London and could not be postponed. But on the outbreak of war the directors felt that no further expenditure should be undertaken on capital account for the moment, and therefore postponed the Hammersmith widening, the further arrangement of moving staircases, and the Euston and Camden Town extensions, which had not been begun; and they were enabled to effect some saving by the closing of one of the unnecessary surface stations at Euston, in October, which was very little used by the public. They could only hope that the situation would soon improve and allow them to proceed with the development of the undertaking. The total capital expenditure for the year was £399,997, and the estimate of further expenditure on capital account was £126,900. The estimated cost of works not yet commenced and in abeyance was £1,204,400; these works comprised the extension from Golders Green, the Hammersmith and Camden Town extensions, and the installation of escalators at Trafalgar Square, Piccadilly Circus, and Tottenham Court Road stations. Turning to the revenue, the gross receipts had amounted to £712,573, being a decrease of £2,746, or .38 per cent. compared with the receipts for the corresponding period. The total expenditure had been £345,001, an increase of £12,145, or 3.65 per cent. Rates and taxes had increased by about £2,400, and it had cost the company £889 for watching and patrolling the line. National insurance had increased by £366. The percentage of operating expenses to gross receipts was 48.6, compared with 46.76 for the corresponding period. Train mileage showed a decrease, although an increase had taken place in the shunting miles caused by the opening of the Paddington extension. The average fare per passenger was 1.69d., as compared with 1.70d. for the corresponding period. The number of season ticket holders had increased. The directors were of opinion that when all the conditions which had prevailed since the outbreak of war were taken into account the results were not unsatisfactory.

Sir Algernon West, G.C.B., seconded the motion, which was carried.

South Metropolitan Electric Light and Power Co., Ltd.

The revenue account for 1914 shows a credit balance of £43,054 plus £5,571 brought forward, making £48,625. After deducting £13,084 for interest on debenture stock paid and accrued, and for other interest, and £6,696 for interim dividends paid on the preference shares, there remains £28,845. Final dividend on the 7 per cent. cum. first pref. shares absorbs £5,004; final dividend on the 6 per cent. ditto absorbs £2,250; there is put to depreciation account £5,000; to credit of "issued expenses" £1,000; to reserve account £10,000, and £5,591 is carried forward.

Year.	Lamps (25 watt). Connected.	Increase.	Consumers.	Gross Revenue.	Expenditure.	Net Revenue.
				£	£	£
1912	258,872	28,681	5,263	56,604	22,670	33,933
1913	289,705	30,833	5,888	65,635	24,065	41,570
1914	330,982	41,277	6,468	66,792	23,737	43,054

Notwithstanding the loss of revenue due to restricted lighting and the disturbance of the normal course of business by the war, the above table shows an increase under every heading except expenditure, which shows a decrease; and the net revenue is nearly £1,500 more than for 1913. In the circumstances, the directors consider this highly satisfactory. The sum which by the provisions of the debenture trust deed has to be set aside to special reserves before payment of any dividend on the ordinary shares, amounted during the past year to £15,374. The surplus profits after carrying £6,000 to depreciation and "issue expenses" accounts, but without making such other reserves, represent a dividend of 8 per cent. on the ordinary shares. The issue of 25,000 six per cent. cumulative second preference shares, made in March last, was over-subscribed, and during the year a further £5,630 four-and-a-half per cent. debenture stock has been allotted. The development of the West Kent Power Company is progressing satisfactorily. New business of a substantial character has been secured, and the prospects are very favourable.

"Two Bills affecting your company's interests were presented to Parliament, one by the London County Council, and the other by some of the London Electric Supply Companies. The former is not being proceeded with, and, as at present advised, your directors do not see their way to support the latter."

Annual meeting, March 1st.

County of Durham Electrical Power Distribution Co., Ltd.

The report for 1914 states:—The total connections to the company's system at the end of the year amounted to 81,887 h.p., an increase of 11,392 h.p. The profit is £23,946 plus £1,111 brought forward. Interest on loans and debenture stock, £12,508, being deducted, the available balance is £12,540. The directors recommend a dividend of 4 per cent. for the year on the preference shares, £10,000. The question of depreciation is being considered in connection with a scheme of writing down the capital.

The expenditure on capital account during the year has been £34,285, of which £32,619 is the outlay on behalf of its associated company, the County of Durham Electric Power Supply Co. The profit for the year has suffered principally through the reduction in the dividend received from the County of Durham Electric Power Supply Co., which company's revenue has been adversely affected by the war. The offer sent out by the Newcastle company to each shareholder of the company of an exchange of shares on certain terms, has been accepted almost unanimously, only four shareholders, representing a nominal capital of £400, not having sent in their acceptances.

Charing Cross, West End and City Electricity Supply Co., Ltd.

In their report for 1914, the directors say that the result, having regard to the exceptional circumstances brought about by the war, cannot be considered as unsatisfactory.

West End undertakings.—The gross earnings of these undertakings from sales of current, rent, etc., were £142,086, as compared with £151,240 for 1913. The expenses, excluding depreciation, were £69,677, as compared with £66,866 for 1913. The net earnings were £72,409, against £84,374. After including £18,000 brought from last year, paying interest on the debenture stock, and providing £22,000 for depreciation, £56,304 remains, out of which the preference dividend for the year absorbs £18,000, and the interim dividend for the half-year at the rate of 5 per cent. per annum on the ordinary shares, £10,000. A final dividend on the ordinary shares is recommended at the same rate, making 5 per cent. for the year. This requires £10,000, and after transferring to general reserve (income) account £304, £18,000 is carried forward.

The company has now connected to its city mains the total equivalent of 718,473 (30 watt) lamps. The total includes 325,436 in lighting, 55,489 in heating, and 337,548 (13,574 h.p.) in motive power.

City undertaking.—The gross earnings of this undertaking from sales of current, rents, etc., were £153,689, as compared with £149,819 for 1913. The expenses were £86,983, against £80,639, and the net earnings were £66,706, against £69,180. Including £18,000 brought forward from 1913, paying interest on the debenture stock, loans and advances, there is a balance on net revenue account of £54,367, out of which has been paid the dividend on the preference shares amounting to £18,000, leaving £36,367, as compared with £38,327 for 1913.

The directors recommend that £18,367 be transferred to general reserve (income) account, and £18,000 carried forward.

The company has now connected to its West End mains a total equivalent of 708,470 (30 watt) lamps. The total is made up as follows:—455,512 in lighting, 33,187 in heating, and 219,771 (8,838 H.P.) in motive power.

The Chief Engineer certifies that the plant and machinery at the several stations of the company have been maintained in a high state of efficiency.

The company is associated with the Brompton and Kensington, Central, Chelsea, Kensington and Knightsbridge, London Electric, Metropolitan Electric, Notting Hill, St. James's and Pall Mall, and Westminster Companies, in promoting a Bill, entitled "The London Electric Supply (No. 2) Bill."

	West End undertakings.	City undertakings.
Units generated	6,432,593	30,161,270
Units bought	9,770,753	391,945
Units sold—Public lamps	439,958	—
Other sales	11,994,327	—
Total units sold	12,434,285	25,424,940
Used on works, and transmission and distribution losses	3,769,061	5,128,275
Total accounted for	16,203,346	30,553,215
Public lamps	303	—
Total maximum supply demanded in KW.	7,024	12,775

Annual meeting, March 4th.

Compania de Electricidad de la Province de Buenos Aires, Ltd.

Mr. S. F. Mendl (Chairman) presided on Friday at Winchester House, E.C., over the third annual meeting of the company. He said that the year under review would not come up to their expectations. They knew of the intense depression in the Argentine and in fact it might fairly be called the crisis, which arose towards the end of 1913, and had lasted without intermission ever since, and naturally, seriously affected a company of that kind. It was true that the provision of electric light and power had become a necessity in Argentina as in other civilised countries, but they were bound to be seriously affected when industrial, financial and commercial conditions in the country were as bad as they had been during the greater portion of the period with which they were dealing. Their revenue had increased by £6,454, which compared with last year's £13,541. They could not altogether complain that the proportionate increase had not been maintained. They had, however, succeeded in effecting radical economies in administration and general charges in Buenos Aires. These charges during the year were £12,500 as against £20,000 in 1912-13, and £21,000 in 1911-12. It must also be remembered that the company did not have the full benefit of the issue of the preference shares, as they were only issued in December, and were not fully-paid until March, 1914. The working expenses ratio shown at stations was 54.72 per cent. which was higher than they anticipated last year, and this was directly due to the depression in the country to which he had referred. If the proportionate increase in revenue had been maintained, and the development of the company had continued, the station working expenses ratio would have been automatically reduced to a much lower level. Another circumstance which had affected their expenses was the sale of the Pergamino station. That was a profitable sale in itself, as they got rid of one of their least satisfactory assets at the price at which it stood in their books, but it affected the expense ratio, as they had to work on a smaller gross undertaking. At the same time, the expense ratio of the new stations they had established at Ramon Mejhia and Caseros were naturally higher than they expected they would be in the future. The Chairman referred to the loss sustained by the company in the death of Baron de Oliveira, the managing director, but said they would not fill the vacancy, in order to carry out their policy of effecting economies in the London administration. The Legislative powers of the Province of San Luis had sanctioned an extension of the control between the municipality and the company for 15 years, and in San Martin they had acquired a new concession from the municipality for 20 years. Since the outbreak of war they had to keep down all capital expenditure to the utmost limits, and the Argentine administration was fully alive to the necessity of husbanding the resources of the company with the utmost possible prudence. Referring to the non-payment of the preference dividend in November, the Chairman explained that the company had earned the dividend, but there had been difficulties in the collection of accounts, and the Board felt they must conserve their funds for the payment of the debenture interest in April. The prosperity of the company, of course, depended on the prosperity of Argentina, and with the passing of the commercial and financial depression in that country, they had every reason to believe their upward course would be resumed on the same scale as before the depression. He had commercial relations with the company, and he believed that the worst of the depression had passed, and that the general financial crisis of the world had done all it could do with regard to accentuating the crisis. Everything in Argentine depended on the crops, and they would be much more satisfactory than for some years. Inasmuch as Argentina produced what the rest of the world wanted, they might look with good hope to a speedy passing of the depression, and an electrical company should share in the return of prosperity. At the extraordinary meeting that followed there would be resolutions submitted for altering the articles of association, and for increasing the capital of the company to £1,350,000 by the creation of 12,500 ordinary shares of £4 each. The alteration of the articles simply provided for a reduction in the remuneration of the directors. There had been some letters of protest from shareholders as to the increase of capital, but his explanation would, he thought, be satisfactory. Under the agreement with the bankers who guaranteed the preference issue their commission was to be paid in ordinary shares instead of cash which was a great advantage to the company. As the Board were considering a drastic reduction in the ordinary capital of the company it was necessary that this commission should be paid now, and hence the increase in the capital. If they left the matter over until after the capital of the company was reduced, then the bankers would be able to claim 12,500 ordinary shares of £4 each, which would probably give them the larger proportion of the capital. By issuing the new shares now the bankers would share in the proposed reduction.

Mr. Guy Hannaford seconded the motion, and it was carried.

At the extraordinary meetings which followed, the resolutions outlined by the Chairman were agreed to.

Mersey Railway Co.

Mr. James Falconer, M.P., presided on Friday over the annual meeting held at Worcester House, E.C. He said that during the latter half of the year the railway had been in the hands of the Government, although it had been worked by the company's staff as usual. The total net income for the year had amounted to £58,267, compared with £58,345 in 1913. The income available for distribution included £1,350, part of a suspense account which had been created from moneys received as compensation in connection with the purchase of certain plant of which delivery was delayed, that enabled them to pay all the debenture-holders' interest in full, except the "B" stock on which they were able to pay one per cent. against the 3 per cent. to which it was entitled. They were therefore able to do better for the debenture holders last year than they had ever done before.

The Chairman, in reply to questions, said that under their Act of 1900, they were empowered to set aside each year to the renewals fund, a sum not exceeding £3,000. For some time they had been setting aside £2,000 year by year, until last year they had accumulated £20,000. They had always had it in their mind, whenever the fund reached that figure, that they would not add £2,000 to it every year, but that each year should be considered on its merits. This year they had had exceptional repairs and improvements in connection with their stokers, and therefore, although they added £2,000 to the fund, they took from it £934, the cost of renewing the stokers. As to the use of the line for its original purpose, there were proposals and Bills passed through Parliament by the Cheshire Lines Committee, authorising the construction of a connection between their station in Liverpool and the Cheshire Lines system, and there were also similar proposals with the Great Central Railway on the Birkenhead side. Had those proposals been carried out, undoubtedly, the railway would have proved a very important means of exchange of traffic on either side, but unfortunately, both schemes were dropped. The possibility, undoubtedly, was still there, and the great advantage to traders and the public was still there, but the enterprise of the other railways concerned was not so keen as it was at the time the Mersey railway was formed, and until that situation was altered, they could not do anything. At the present time particularly, financial matters were in such a condition that the raising of capital would not be considered by anybody.

The report was adopted.

Subsequently, a special meeting was held at which a resolution was agreed to approving of a Bill which the company is promoting in Parliament for an extension for five years of the period during which the payment of interest on certain of the debenture stocks is contingent on the available net revenue of the company.

Sunderland District Electric Tramways, Ltd.

The directors report that for the year ended October 31st, 1914, after providing for interest on the prior lien bonds and the first mortgage debentures, and for sinking fund instalment, and making provision for depreciation on investments, there remains a net profit of £2,179 plus £217 brought forward. The payment of interest at the rate of 2½ per cent. per annum (less income tax) on the first income bonds will absorb £1,752, leaving £644 to be carried forward. During the year the provision of suitable housing accommodation for the staff has been proceeded with, and eight houses in course of erection are now approaching completion.

The traffic receipts showed an increase up to the end of July last of £2,246 over those for the corresponding period of the

previous year, but owing to the outbreak of war the receipts for the remaining three months of the financial year decreased by £667, leaving a net increase of £1,579 for the year.

Mr. H. R. Hogg presided on Monday at the annual meeting, held at Balfour House, E.C. He said that during the past year the undertaking had progressed particularly well, and the receipts showed a healthy increase up to the date of the war. Immediately on the outbreak of hostilities the receipts fell and instead of showing a weekly increase on the previous year's earnings, turned what had been a net gain of 10 per cent. into a weekly reduction of about the same amount. That, however, occurred for only three months of the financial year, and the accounts, therefore, showed satisfactory features. The traffic receipts amounted to £29,966 which, with sundry additions, gave them a total income of £31,729. The working expenses, in spite of increased wages to the whole of the staff, were reduced from 61.19 per cent. on the gross takings the previous year to 56.84 per cent.—a very satisfactory reduction. The number of passengers carried was 4,719,579, an increase of 228,194. Last year they provided 15 new cars, and during that and the present year 18 older ones had been completely renovated at a cost of £4,170; some badly wanted additional buildings had been completed, and the permanent way and overhead equipment had been kept in good order at a cost of £1,983. They were, therefore, well prepared for the coming summer, when their lines were most fully employed. They had written off £2,343 for depreciation of rolling stock, buildings, etc., which the auditors considered sufficient. Like all who had funds invested in high-class securities, they had suffered from the fall in prices, and had therefore retained a sum of £1,000 as a reserve to cover the difference between the cost of the investments and a valuation as at 27th July last. Something like a third of the staff having joined the colours, they had had to employ and teach new men to take their places. The Board were proceeding with the erection of houses for the men, so as to have them near their work. They had provided for the manager, and had just completed eight cottages for the men, and as soon as they were filled they intended to start with some more, the land purchased having room for 22. That would accommodate about one-third of the total men employed.

Mr. C. Eves seconded the motion, and the report was adopted.

Notting Hill Electric Lighting Co., Ltd.

Sir Wm. Crookes, presiding at the annual meeting held at Winchester House, E.C., on Tuesday, said that no new capital had been created for issue for several years. They had spent £4,128, principally, as usual, for mains, and secondly, for meters, to pick up new customers; the additional business would show a profitable return in the future. They had spent £42,768 in excess of the capital received, by employing their reserves in the business.

Considering the circumstances prevailing, the revenue account must be considered satisfactory, and it reflected credit on the whole of the staff. The expenses were nearly £300 below the previous year, and the profit worked out at £24,221 against £24,465. The revenue showed a reduction of £527, due solely to the war regulations imposed by the Government, compelling consumers to reduce their lighting. Up to the end of September their revenue each quarter showed a nice increase, but the last quarter they knew was bound to be disappointing, and they estimated that the loss in net revenue was about £2,000. They were still suffering considerably, and obviously, they must continue to do so until the Government was able to remove the restriction as to lighting. Allowance had since been made in the account for the bonus to the staff, under their co-partnership scheme, which, they would remember, was based on the amount of profit available for dividend on the ordinary shares. The staff appreciated the concession, and would receive an addition of about 8 per cent. to their wages. By the depreciation, renewal and reserve fund account, it would be seen that the total reserve to be carried forward was £45,545, which in their opinion was a very satisfactory sum. They charged against the fund last year £605 for meters which were too old for further service, and with the metal filament lamps, it was more than ever necessary that meters should be in good order, otherwise they omitted to register when a very small quantity of current was passing. The Kensington and Notting Hill Joint Debenture Stock Sinking Fund continued to increase at a very even rate, and they had contributed £17,532 to it, but the total was £66,045. The balance was made up by the amount of the Kensington company's contribution, and further by the fund being invested at compound interest, which should result in the company having a valuable asset in 1931, when the stock was redeemed.

The Chairman referred to a table prepared, showing the progress of the company from its inception. The table showed that they added the equivalent of 12,258 lamps of 8 candle-power during the year, which was more than for many years past, and it was only the restricted lighting of London that had prevented the accounts from indicating a corresponding increase in revenue. In addition to their loss of revenue, he must say that, including men from the joint works, 15 had joined His Majesty's Forces, and were being paid part wages, which amounted to over £550 a year, but they felt the shareholders would approve this patriotic way of treating those who were helping to win for them a glorious and lasting victory in this deplorable war. They had also been hit in another way by the war, as they had on order for Wood Lane a new generating set which was guaranteed to reduce the cost of production considerably, and should have been running by now. However, just as it was ready for delivery, the Government commandeered it for very important work of their own, and they would probably not get delivery of another set until the end of the year. The directors had referred in their report to the Bills which had been promoted this session on the London electric supply question. As had been explained, the Bill promoted by the L.C.C. did not receive the votes of a sufficient majority of the Council to approve it, and it had since been abandoned by the Council. The company, however, joined with nine other London electric lighting companies in promoting the London Electric Supply (No. 2) Bill, but the Government had just decided that this would not be allowed to proceed, as it came within the category of those Bills which were of a public character, and raised questions of a contentious nature. It had, therefore, been agreed to withdraw the Bill. If it had passed the first House, the directors would have called the shareholders together to obtain their approval before proceeding with it, and he had intended to give them that day certain information respecting it, and also to inform the shareholders that during the time the Bills had been in preparation, the companies had been in negotiation with the L.C.C. with a view to formulating a scheme of sale acceptable to all parties. Recent developments rendered it uncertain as to what might be done in future in the direction of an agreement with the County Council, but he would assure the shareholders that the directors were carefully guarding their interests. The Chairman expressed their great regret at the loss they had sustained by the death of their colleague, Sir Joseph Swan.

Mr. A. E. Franklin, in seconding the motion, said the Chairman had asked him to say a few words with regard to the conference of the various electric light companies. They had heard that in the exceptional circumstances under which Parliament was meeting, the Bill would not proceed, but the shareholders might take it that the close association which had been existing during the whole of the negotiations would certainly have the effect of facilitating any future movement that might take place for the metropolitan interests, which might come forward hereafter. The contentious matter raised in the Bill was of two classes, and probably it would not have amounted to much, had the Bill gone into the Committee Rooms. One matter really lay between the Borough Councils and the County Council, namely—that of their respective interests in the future of electricity. That was a matter which did not concern them. The other point was one of great public interest. There was a certain school of electrical companies who advocated the concentration of the production of electricity in one spot, and who followed the schemes instituted in America, where there was such concentration, and where, obviously, the working costs were much lower, because the output was much larger. The other view to which they and other Boards strongly adhered, was that in view of the public danger which would exist in having one place for the supply of electric current to London, such a scheme, however economical, was impossible of introduction to a city like London. It was almost too dreadful to contemplate what would happen if all their power and light were concentrated in one place where a single bomb dropped from a Zeppelin or an aeroplane might put them in darkness for a long period.

The motion was carried.

The retiring directors and auditors were re-elected, and, on the motion of Mr. Horace Boot, seconded by Mr. Davies, a hearty vote of thanks was passed to the Board and staff.

Newcastle and District Electric Lighting Co., Ltd.

The directors report that during 1914, 19,271,853 units were sold, as against 16,863,440 in 1913, an increase of 14 per cent. The gross profit was £32,031 plus £10,076 brought forward. Deducting interest on debentures and loans, £16,620, and interim dividend paid last August, £4,193, the available balance is £21,294. A dividend at the rate of 3 per cent. per annum (less income tax) for the half-year ending December is to be paid (making, with the interim dividend, 3 per cent. for the year); this requires £4,044; transfer to second mortgage debenture redemption fund, £2,132; written off debenture issue expenses, £500; carry forward, £14,617. The directors have redeemed a further £2,060 of the company's 6 per cent. second mortgage debentures. Capital expenditure for plant and mains required to connect the systems of supply in Newcastle and Newburn has amounted to £31,274. The war has considerably affected the profits during the year, chiefly owing to its causing delay in the completion and consequent erection of the new plant provided for by the third mortgage debentures. During the current year the company will for the first time get the benefit of this expenditure. Impending additions at the Close works, Newcastle, will involve certain capital expenditure, and shareholders will be asked to sanction an increase of borrowing powers by £50,000. Particulars will be given at the annual meeting on March 5th.

Capt. Frank Buddle Atkinson has been elected to a seat on the Board.

Oxford Electric Co., Ltd.

The revenue account for 1914 shows a profit (including £982 brought forward) of £14,917. After providing £2,091 for debenture and other interest, and writing off £770 on account of hire-purchase installations, the balance available is £12,055. A dividend at the rate of 6½ per cent. per annum, less income tax, on the ordinary share capital (whereof 2½ per cent. was paid in September last) absorbs £6,500; five per cent. per annum on the preference shares, £2,500; there is placed to reserve and renewal of plant, £2,000, leaving to carry forward, £1,055. Reserve and renewal of plant account has been charged with the cost of plant replaced. The outbreak of war has adversely affected the costs of production and revenue charges, but notwithstanding the exceptionally unfavourable local conditions created, the sale of electricity has exceeded that of the preceding year. The supply mains of the company have been extended in Warneford Road, also in High (St. Thomas), St. Clement's and Leopold Streets.

Annual meeting, March 5th.

Scarborough Electric Supply Co., Ltd.—The annual report states that during 1914 there has been connected to the company's mains the equivalent of 8,031 (30-watt) lamps, making a total to date of 130,905. The units supplied, including the 300,000 minimum supply to the tramways, were 1,012,847. After placing £1,000 to depreciation account, there is a balance on revenue account of £3,847. The directors recommend that a dividend of 2 per cent. for the year be paid, less income-tax, absorbing £2 000, leaving £1,847 to be carried forward. The carry forward is large, but the directors state that the exceptional existing circumstances make this desirable. The directors express their great regret at the loss sustained by the company through the death of Mr. John Hall, who had filled the office of secretary to the company since its formation in 1892. They place on record their appreciation of his faithful services.

Listowel, County Kerry, Electric Light Co., Ltd.—The annual meeting was held at Listowel, Mr. J. Macauley presiding. Mr. E. L. Cantwell, manager and secretary of the company, presented the annual report, showing that the gross profits for the period were £295, plus £8 brought forward. There was placed to reserve £150, leaving available for dividend £154. It was resolved to declare a dividend of 7 per cent. for the period covered by the accounts, and to carry forward the surplus. The chairman said that they had reason to congratulate themselves on the very satisfactory position, and he referred to Mr. Cantwell's very capable conduct of the business.

Companies Struck off the Register.—The following companies have been struck off the Register, and are accordingly dissolved :—

British Engineering and Fume Condensers.
British Speedometer Control Co.
British Wireless Telegraph Syndicate.
Civil Engineering Press.
Electrical Fittings Co. (1911).
Electrical Amusements.
Electrocoustics.
Insulators.
Internal Combustion Engines Cooling Agent Co.
National Electric and Motor Corporation.
Patent Tube Covering and Lining Co.
Rotary Pulsating Plunger Pumps.
Smoke Abaters.

Aberdeen Suburban Tramways Co., Ltd.—The profit earned during the half-year ended January 31st, 1915, was £1,153, making, with the sum brought forward from last half-year's accounts, a balance of £2,445 at the credit of the profit and loss account. The directors report that they have been approached by the Corporation of Aberdeen with a view to the purchase by the Corporation of the company's undertaking. Negotiations are, meantime, pending, and if terms are proposed by the Corporation which the directors feel justified in submitting for the approval of the shareholders, a meeting with the shareholders will be called for the purpose of considering them.

Jarrow and District Electric Traction Co., Ltd.—The report for 1914 states that the total revenue amounted to £7,870, an increase of £137 as compared with 1913. After deducting all expenses chargeable to revenue, including interest on debentures and loans, and making a provision of £800 for renewals, there remains a surplus of £2,647, plus £1,028 brought forward. There is to be placed to reserve £900, dividend on the ordinary shares at the rate of 3½ per cent. for the year absorbs £1,748, and £1,026 is to be carried forward. Passengers carried: 1913, 1,531,434; 1914, 1,571,546. Receipts per passenger: 1913, 1·19d.; 1914, 1·18d.

Annual meeting March 1st.

Chelsea Electricity Supply Co., Ltd.—The directors recommend a dividend for the last half of 1914 at the rate of 6 per cent. per annum on the ordinary capital, making 5 per cent. for the year, after paying debenture interest and placing £14,320 to depreciation fund, £704 to debenture premium redemption fund, writing off £1,089 from the cost of extinction of foundera' shares, and £1,429 off cost of investments; carrying forward about £3,196. The dividend is the same as for 1913.

Blackpool and Fleetwood Tramroad Co., Ltd.—The annual meeting was held on February 19th, at Manchester, Mr. John Greenwood presiding. The chairman said the available balance was down by £3,843 compared with 12 months ago. With regard to the future they were faced with a claim by the Urban District Council for a contribution towards the making of a new road. The road itself would be contiguous to the tramline, but it might as well be a mile away so far as it could benefit their own concern. Out of their staff of 125 men, 25 had joined the Forces of the Crown, two of their drivers, he was sorry to say, having been killed in action. The directors proposed to deal with the dependents who were left. He added that it was possible in the near future that they would have to expend a considerable sum on the relaying of the lines in Fleetwood. The report was adopted.

Compagnie Générale d'Electricité.—This French company, which has an ordinary share capital of £1,000,000 and a reserve fund of an equal amount, reports a very favourable increase in the turnover in 1914, and in particular the central stations at Amiens, Marseilles, and four other towns experienced a growth of almost 25 per cent. in the receipts. The net profits amounted to £148,000, and rose to £223,000 on the addition of the sum brought forward from 1913, this surplus comparing with £146,000 in the preceding year, when a dividend of 10 per cent., or £2 per share, was paid. The state of war, however, has induced the company to postpone for the present any distribution of profits for 1914.

Fife Tramway, Light and Power Co., Ltd.—The profits for the year (together with the balance carried forward), after paying loan interest and interest on debenture stock and providing instalment for debenture stock redemption, amount to £19,271. Out of this £4,205 was paid as interim dividend on the preference shares. The directors recommend a dividend on the preference shares for the half-year at the rate of 6 per cent. per annum, £5,998; 3½ per cent. dividend on the ordinary shares, £3,263; £3,000 to reserve stock, and £2,803 carried forward.—*Financier.*

County of London Electric Supply Co., Ltd.—The directors recommend payment of final dividends upon the preference shares at the rate of 6 per cent. per annum for the half-year to December 31st, less income-tax, and on the ordinary shares at the rate of 9 per cent. per annum, less income-tax, for the half-year to December 31st, making 7 per cent. for the year on the ordinary shares. £40,000 has been placed to reserve for depreciation, leaving £10,000 to carry forward.

W. T. Glover & Co., Ltd.—The directors recommend a dividend for the year ended December 31st, 1914, of 5 per cent. on the ordinary shares. After allocating £6,500 to debenture redemption funds, transferring £5,000 to reserve fund, and writing down certain quoted investments to their estimated values as at December 31st, 1914, a balance of nearly £8,000 remains to carry forward.—*Financial Times.*

Stock Exchange Notices.—Applications have been made to the Committee to allow the following to be quoted in the Official List :—

Interborough Rapid Transit Co.—$5,000,000 additional first and refunding mortgage 5 per cent. gold bonds for $1,000 each Nos. 93,659 to 98,658.

Waygood-Otis, Ltd.—Further issue of 15,000 ordinary shares of £1 each, fully paid; and 15,000 6 per cent. cumulative preference shares of £1 each, fully paid.

Vulcan Boiler and General Insurance Co., Ltd.—The net profit for 1914 is reported at £56,736 plus £9,320 brought forward. The dividend and bonus for the year amount to 25 per cent., £7,500 is placed to current risk and reserve fund, £1,200 to superannuation and benefit fund, and £10,481 is carried forward.

Mirrlees Watson & Co., Ltd.—We read in a financial daily that the accounts for the year 1914 show a loss of £12,649, from which falls to be deducted the credit balance of £5,504 brought forward, leaving £7,145 at the debit of profit and loss account to be carried forward.

Tramways, Light and Power Co., Ltd.—The receipts for 1914, including £1,126 brought forward, amount to £29,174, and after providing for administration, loan and debenture interest, the profit amounts to £18,329. The directors propose (says a financial daily) to pay the dividend on the preference shares, and to carry forward £1,712.

London Electric Wire Co. and Smiths, Ltd.—According to the *Financier* the directors recommend a dividend of 7½ per cent. (7s. 6d. per share), less income-tax, on the ordinary shares for the last half of 1914, making 10 per cent. for the year, placing £40,000 to reserve (making £110,000) and carrying £25,952 forward.

Mexico Tramways Co.—It is stated that the directors are deferring the payment of the half-yearly coupon due on March 1st on the general consolidated first mortgage 50 year 5 per cent. gold bonds.

Bournemouth and Poole Electricity Supply Co., Ltd.—We are informed that the recent issue to shareholders of 2,500 cumulative 6 per cent. second preference shares was largely over-subscribed. Letters of allotment were posted on 18th inst.

STOCKS AND SHARES.

Tuesday Evening.

THE tendency in Stock Exchange markets at the present time is disposed to heaviness. Everybody and everything seem to be waiting. The progress of the war is necessarily slow, and the main excitement lies in the Eastern zone of operations, where Russian and German armies drive each other backwards and forwards with a violence and over a length of country difficult to realise by us on this side. Every day one meets in the City, men home on leave from the French trenches who agree in their reports of the stale-mate character of the present fighting; and their personal experiences coincide with the official *communiqués* to show that until weather conditions change, no great alteration is likely in the existing order of affairs.

The much-advertised blockade rouses little more than passing interest in the City—in illustration of which the financial eye-witness cites the steadiness of shipping securities. A theory that finds increasing support amongst the prophets is that Germany is deliberately endeavouring to array the world against her, in order that she may be able to excuse defeat by the declaration that she cannot fight the universe, although she could boast of her vaunted ability to beat the powers at present opposed to her—which, by the way, would be at least a claim in perfect keeping with many of the other absurdities preferred by this ever-truthful nation.

The electric lighting companies are doing pretty well, having regard to the circumstances under which they have worked during the last five months of 1914 and the difficulties with which they are faced now. The London Electric Supply Corporation has actually increased its dividend, paying 4 per cent. against 3 per cent. a year ago, and so repeating a performance which it has not equalled since 1906. In 1907, the dividend dipped to 2½ per cent.; in 1908 and 1913 it was 3 per cent.; in 1909 and 1910 the directors paid 2 per cent. The reserves now stand at £136,000; and the price of the shares has risen to 30s.

The Chelsea Company announces a dividend making 5 per cent. for 1914, the same as that for 1913. At 4¾ the yield on Chelseas comes to £5 11s. 1d. per cent. on the money.

The feature of the St. James's report is the small decrease in profits, considering war conditions. For 1913, 12 per cent. was distributed; but the current dividend of 10 per cent. is a repetition of the rate paid from 1906 to 1912 inclusive. Since the company was incorporated, the sum of £280,000 has been written off in depreciation. There is a capital reserve fund of £66,500, and an emergency fund of £20,000.

The Notting Hill Company's net profit of £24,324 was the bagatelle of £141 less than that for 1913, and the 5s. dividend for the year maintains the rate paid since 1912. Its appropriations amount to £45,500, and the capital expenditure up to December 31st last came to £252,000.

The South Metropolitan has paid no dividend on its ordinary capital since 1908, but its net profit for 1914 shows an improvement of £1,500. In addition to the usual £5,000 to depreciation account, twice that sum is carried to reserve, thereby doubling it and bringing it up to £20,000.

Market changes on the week are unimportant. A fair line of South Londons changed hands on the basis of 3 to 3 1/16, and the exceptional bargain at 56¼, marked at the end of last week was probably in respect of shares sold *ex* the dividend of 4s. County of London Preference are easier at 11. Metropolitan 3½ per cent. Debenture stock advanced to 80, bringing it to a level with the similar security of the St. James' Company. The yield at this price is £4 7s. 6d. per cent. on the money invested.

The following tables show rises and falls on the week, in representative securities:—

HOME ELECTRICITY COMPANIES.

	Mean price. July 27.	Feb. 23, 1915.	Rise or fall this week.
Brompton Ordinary	9⅛	8⅞	—
do. 7 per cent. Pref.	8⅝	8⅝	—
Charing Cross Ordinary	5⅛	4⅛	—
do. do. do. 4½ Pref.	4⅜	4⅜	—
do. do. City Pref.	4⅜	4	—
do. 4 Deb.	91½	90	—
Chelsea	4⅝	4⅝	—
do. 4½ Deb.	96½	92	—
City of London	16	14⅛	—
do. do. 6 per cent. Pref.	13⅛	12⅝	—
do. do. 5 Deb.	116½	112	—
do. do. 4½ Deb.	100½	98	—
County of London	12	11	—
do. do. 6 per cent. Pref.	12	11	— ⅛
do. do. 1st Deb.	102½	99	—
do. do. 2nd Deb.	101½	97	—
Kensington Ordinary	7⅛	7⅛	—
London Electric	1 7/16	1⅛	+ ⅛
do. do. 6 per cent. Pref.	5 7/16	5⅛	—
do. do. 4 Deb.	92½	87	—
Metropolitan	3⅛	3⅛	—
do. 4½ per cent. Pref.	4 1/16	4	—
do. 4½ Deb.	97½	96	—
do. 3½ Deb.	83	80	+2
St. James' and Pall Mall	9⅜	9	—
do. do. do. 7 per cent. Pref.	7	6½	—
do. do. do. 3½ Deb.	84½	80	—
South London	3 3/16	3	—
South Metropolitan Pref.	1⅛	1⅛	—
Westminster Ordinary	8⅜	8½	—
do. 4½ Pref.	5⅛	4⅛	—

HOME RAILS.

	Mean price. July 27.	Feb. 23, 1915.	Rise or fall this week.
Central London, Ord. Assented	83	77	—
Metropolitan	37½	29	—1
do. District	21¼	17⅛	— ⅛
Underground Electric Ordinary	2⅛	1⅞	—
do. "A"	7/6	6/-	—
do. Income	88	83	— ½

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pf.	108½	104 xd	—1
do. Def.	28	21⅜ xd	— ⅛
Chile Telephone	7⅜	6⅜	— ⅜
Constantinople Tel.	4¼	3⅜	—
Cuba Sub. Ord.	8½	8½	—
do. Pf.	16⅜	12½	—
Eastern Extension	12⅝	12⅝	—
do. 4 Deb.	97½	92 xd	—
Eastern Tel. Ord.	130½	127	—1
do. 3½ Pf.	77⅛	72	—
do. 4 Deb.	96½	94	—
Globe Tel. and T. Ord.	11½	10⅜	+ ⅛
do. Pf.	12⅞	11⅝	—
Gt. Northern Tel.	32½	28	+1
Indo-European	59	55	—
Marconi	1 1/16	1⅛	—
New York Tel. 4½	101	97	—
Oriental Telephone Ord.	2 5/16	2	—
do. Pf.	1 3/32	1 3/16	—
Tel. Egypt Deb.	98	88½	—
United R. Plate Tel.	6⅜	6	—
do. Pf.	5½	5	—
West India and Pan.	1½	1 5/16	—
Western Telegraph	13⅜	13	—
do. 4 Deb.	96½	95½	—

FOREIGN TRAMS, &c.

Anglo-Arg. Trams, First Pf.	4⅞	4⅛	— ⅛
do. 2nd Pf.	4½	4	—
do. 4 Deb.	91	84	—
do. 4½ Deb.	96½	93	—
do. 5 Deb.	96	88	—
Brazil Tractions	66	49½	—2½
Bombay Electric Pf.	11⅜	10⅜ xd	—
do. 4½ Deb.	96	91	—
Mexico Trams.	70	35	—
do. 5 per cent. Bonds	84	60	—
do. 6 per cent. Bonds	76	50	—
Adelaide Sup. 6 per cent. Pf.	5½	5 1/16	+ 1/16
do. 5 Deb.	104	102	+ ⅛

MANUFACTURING COMPANIES.

British Westinghouse Pref.	1⅜	1 1/16	+ 1/16
do. 4 Deb.	74½	72	+2
do. 6 p. lien	102½	98½	—
Callenders	11⅞	11⅜	+ ⅛
do. 5 Pref.	5⅛	4⅞	—
do. 4½ Deb.	98½	98	—
Castner-Kellner	2⅜	8½	—
Edison & Swan, £3 pd.	3/32	11/6	—
do. do. fully paid	1½	2	—
do. do. 4 Deb.	59	60	—
do. do. 2 Deb.	68½	60	—
Electric Construction	1/7	13/-	—6d.
do. do. Pf.	1/32	1	—
Gen. Elec. Pf.	10⅜	10	—
Henleys	15	14	+ ½
do. 4½ Pref.	5	5	—
do. 4½ Deb.	100½	97	—
India-Rubber	9	8½	—
Telegraph Con.	38½	37	+ ½

Brazil Tractions have been flat, another fall of 2½ points lowering them to 49½. The market professes to be puzzled to account for the drop, and can only put forth the excuse—as lame as it is trite—of there being more sellers than buyers. Rio exchange is better to-day at 12 1/16d., but Brazil Tractions continue to crumble. Singapore Electric trams weakened to 3s., on rumours that one of the native regiments had run amok, though the trouble is said to have been composed by now. This report is a variation of that which declared the town to have been bombarded by the *Kronprinz Wilhelm*. Adelaide Supply Preference improved to 5 3/16, but, on the other hand, Anglo-Argentine 1st Preference lost ⅛. The Mexican issues are quiet.

Telegraph stocks and shares present a front rather less bold than they have lately displayed. The Eastern group is dull, Eastern Telegraph Ordinary being on offer at 127; probably a cheaper bid would dislodge stock. The Anglo-American Telegraph division is also a little easier, and it is suggested that the would-be German blockade may have aroused some desire on the part of timid cable stock holders to realise their holdings. Personal experience, however, has failed to confirm this in any way. Great Northern are £1 better. Chili Telephones relapsed. Marconis are quiet and steady. There is not much doing in the market as a whole.

Henleys at 14 and Telegraph Constructions at 37 are both 10s. higher on the week. British Westinghouse issues are good, the Preference and 4 per cent. Debenture both showing rises. Electric Constructions again went back a trifle.

In the rubber market the principal feature is the steady strengthening of the market for the raw material. Rubber creeps up a farthing per lb. at a time, and holds on a steady upward course. The share market has scarcely responded to the firmness of that in the product. Amongst armaments there is not much going on. A good deal of strength is shown by the popular descriptions—Vickers and Armstrongs more particularly. Certain of the iron companies are rather out of favour, and a little desultory selling from the North of England has led to reactions in some of the best-known shares.

Para Electric Railways and Lighting Co., Ltd.—The directors recommend a dividend of 6 per cent., less income-tax, on the ordinary shares for 1914, carrying forward £20,030.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JANUARY, 1915.

The returns of electrical exports and imports for the first month of the year show a decided improvement in the case of the former, while the latter exhibit a considerable decrease in value.

Thus the exports from this country reached a total value of £364,562, as compared with £290,069 in December last, while the imports for January were valued at £239,127 as against £261,303, and the re-exports at £12,455 compare badly with the £25,510 recorded for December.

A glance at the export figures shows that while our output of machinery and goods and apparatus has fallen off, this has been more than made up in improved business in other directions, principally in cable, telegraph and telephonic exports.

Machinery imports were somewhat heavier than in December, but a considerable falling off occurred in the importation of cables, telegraphic and telephonic apparatus and lamps. The feature of the imports is the great increase in U.S.A. business, which reached £198,596 in value during January, an increase of over £30,000 on December last.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	6,024	2,055	435	221	...	903	2,046	23	530	100	367	6,108	18,812
Germany	...	...	...	...	...	...	...	...	...	...	...	...	...
Netherlands, Java and Dutch Indies ...	103	3,178	291	...	412	213	2,351	148	100	...	17	1,593	8,406
Belgian Congo	17	...	...	...	...	...	...	...	...	...	...	...	17
France	1,274	1,000	903	226	380	...	855	63	713	43	5,176	4,807	15,440
Portugal	30	1,282	...	70	2	...	176	1,025	22	2	127	285	3,021
Spain, Canary Isles and Spanish N. Africa...	139	213	246	96	...	19	948	201	...	13	...	...	1,875
Switzerland and Italy	212	55	249	...	37	971	3,293	...	15	375	16	14,642	19,865
Greece, Roumania and Bulgaria	...	...	56	...	85	...	600	...	143	...	2,270	...	3,154
Channel Isles, Gibraltar, Malta and Cyprus...	157	97	72	80	...	16	50	...	390	...	10	...	872
U.S.A., Philippines and Cuba	328	...	842	34	...	19	97	...	11	...	...	...	1,331
Canada and Newfoundland	1,554	85	255	714	...	1,738	2,965	...	348	22	...	6 374	14,055
British West Indies and British Guiana ...	168	26	202	31	...	94	64	...	113	...	12	64	774
Mexico and Central America	104	90	96	94	...	74	55	...	...	...	...	...	513
Peru and Uruguay	32	152	60	71	...	...	83	208	54	...	218	5,731	6 609
Chile	97	122	10	249	...	...	1,183	...	12	104	...	3 347	5,124
Brazil	31	625	606	181	...	87	759	814	331	9	...	279	3,722
Argentina	569	9,226	1,230	119	...	429	4,036	1,543	391	22	535	958	19,058
Colombia, Venezuela, Ecuador and Bolivia...	...	89	...	80	...	10	705	...	...	...	62	...	946
Egypt, Tunis and Morocco	201	285	89	13	...	175	187	7	196	55	280	1,740	3,228
British West Africa	12	136	7	15	...	...	779	...	30	...	94	2,472	3 545
Rhodesia, O.R.C. and Transvaal	128	490	776	195	...	51	1 694	12	48	26	25	23	3,468
Cape of Good Hope	178	3,022	139	470	...	36	1 589	1,150	99	...	177	360	7.220
Natal	100	1,903	188	113	...	26	3,860	...	...	86	...	135	6.411
Zanzibar, Brit. E. Africa, Mauritius & Aden	79	88	44	304	...	128	203	153	22	...	4	20,368	21,393
Azores, Madeira and Portuguese Africa ...	22	213	42	135	...	71	1,339	...	...	...	24	65	1,911
French African Colonies and Madagascar...	...	...	...	...	...	...	...	...	...	...	...	...	...
China and Siam	942	691	972	109	109	684	985	858	498	...	11	12,805	18 664
Japan and Korea	533	...	15	...	...	376	3.079	...	674	18	...	391	5.086
India	2,602	12.907	1,926	1,842	23	1,869	15,380	2,759	1,964	228	4,090	1,219	46,808
Ceylon	42	32	153	90	...	...	44	...	273	...	199	216	1,049
Straits Settlements, Fed. Malay States and Sarawak	464	667	226	69	...	88	11,447	80	304	89	77	2,769	16,280
Hong Kong	319	112	344	...	...	...	70	...	1,208	...	200	...	2,253
West Australia	127	347	139	56	36	2 615	1,867	92	150	...	50	103	5,582
South Australia	89	1,185	419	113	47	176	2.421	...	58	3	896	...	5.407
Victoria	2,158	8,457	1,848	393	166	2 891	3,018	2 070	501	...	3,293	...	34.795
New South Wales	243	6,320	2,283	1,207	47	1,188	4,738	7,647	11,942	...	2,626	2,103	40,344
Queensland	317	48	117	618	...	27	1,326	15	735	...	770	99	4,072
Tasmania	...	58	...	...	...	...	...	...	33	...	25	20	136
New Zealand and Fiji Islands	527	1,699	1,226	480	51	1,506	4,961	32	371	57	742	1,664	13,316
Total, £	19,922	66 955	16,506	8,488	1,395	16,480	79,253	18,900	22,278	1,252	22,393	90,740	364,562

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	73	...	758	27	812	149	2,076	614	450	2,717	4,270	11,946
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	495	70	23	3,567	1,861	...	166	68	681	...	1,674	8,605
Belgium	88	...	...	...	...	...	...	...	...	...	...	88
France	225	14	844	39	1,077	394	9	...	125	1,146	1,490	5,363
Switzerland	147	...	68	119	...	1,332	4,501	...	...	1,336	...	7 503
Italy	266	4,168	31	...	...	...	263	...	10	...	...	4,738
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	3,796	1,169	2 937	337	4,016	674	29,022	145,161	8,071	2,821	592	198 596
Total, £	5,090	5,421	4,661	4,089	7,766	2,549	36,037	145,843	9,337	8,020	8,026	236,839

Additional Imports: Spain, carbons, £1,995; Canada, fittings, £20, machinery, £263, batteries, £10.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	794	255	3,974	204	...	122	3,209	...	78	249	3,570	12,455

TOTAL EXPORTS: £364,562 TOTAL RE-EXPORTS: £12,455 TOTAL IMPORTS: £239,127

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third column contains many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

POLYPHASE COMMUTATOR MACHINES AND THEIR APPLICATION.

By N. SHUTTLEWORTH, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Birmingham, February 10th*, 1915.)

(*Concluded from page* 245.)

The angle θ between the counter-voltage of rotation and the impressed voltage on the machine can only be obtained by proper adjustment of the phase of a field flux and exciting voltage. It is determined by the phase of the exciting voltage derived from the secondary (3) of the transformer, which as previously intimated may be regulated by a turning movement.

It might be possible to employ a motor of the kind for fan driving where there is an opportunity of varying the power factor (namely, varying the angle θ) after each change in load.

The one essential for successful operation and good characteristics is that θ should vary in direct proportion with the load current. Under this condition the current would remain in phase with the voltage at unity power factor under all loads, and the speed would be appreciably constant.

Whether M. Latour embodies features such as this in the actual machine it is impossible to say, but from the success that he claims it would seem probable.

Whatever the methods employed by M. Latour, to obtain a successful motor on these principles, especially for a frequency as high as 50 cycles, it is quite certain that there is considerable auxiliary apparatus in addition to the motor itself, and this tends to make the equipment very costly. However, machines of this type are stated to be in commercial operation.

For small sizes the speed range is considerable, and becomes greater the smaller the machine (50 per cent. above and below synchronism at 25-h.p., 50 cycles; 23 per cent. at 200-h.p.). For large sizes the speed range is very limited, and is not sufficient for the usual practical requirements.

Another example of a variable-speed motor with shunt characteristics is the Eichberg 3-phase commutator motor, represented by fig. 8. The motor is simply an armature fitted with a compensating winding, and exciting voltages are impressed from the auxiliary auto-transformer, which is permanently connected in star to the supply system, and is provided with tappings, each of which may in turn be connected to the brushes of the motor. It will be observed that by varying the ratio of the two arms in each phase of the auto-transformer there is a different ratio between the armature and compensating-winding voltages on the motor, and this, as previously seen, implies variable armature speed.

The very fact that the armature and compensating winding have an equal number of turns and are wound in opposite directions prevents energy being transferred from stator to rotor, or vice versa, by induction. An auto-transformer connected in parallel cannot therefore act as a power transformer, and it carries only the wattless exciting current required by the motor. Speed regulation by the means described is a comparatively simple matter.

Unfortunately, if good operation is to be maintained, this simple motor cannot be constructed with a sufficiently large number of turns in the armature to suit normal supply voltages. It is quite imperative in practical machines that the number of armature turns be considerably reduced. This being so, the auto-transformer at once becomes a power trans-

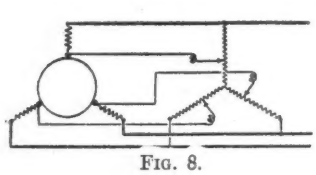


Fig. 8.

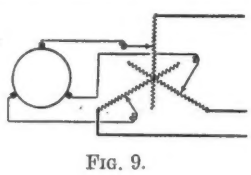


Fig. 9.

former, and delivers a portion of the total input of the motor direct to its armature at comparatively low voltage and heavy current. The effect of the change is considerably to increase the capacity of the transformer, and it entails also a massive controller to deal with the heavy currents between the transformer and the brush-gear.

The necessity for a transformer, however, vanishes when the stator and rotor turns are no longer equal, as it becomes possible for power to pass from stator to rotor by induction, and the functions of a transformer may be embodied directly in the motor in addition to its previous duties. The modified machine is shown in fig. 9, where it will be seen that the existence of a field in the motor is made positive by closing the star point of the stator winding, and tappings are brought out from it to which the brush studs of the armature are connected by means of the controller.

The latest type is represented by fig. 10; the star point of the stator winding in this case is closed through a polygon, and the intention is evidently to impress on the armature a voltage which is slightly dephased from the true star voltage of the supply system. A phase displacement of this nature brings about an improvement in the power factor.

To be strictly accurate the angle of the phase shift must vary with each speed, but as this is impracticable the improved power factor is obtained at a few speeds only. The stator winding is continued and is provided with tappings below the star point so that speed regulation may be obtained below synchronous speed as well as above.

The possible speed variation with this type of motor approximates to that given for the Latour motor, but the output limits are considerably smaller. No proper provision can be made

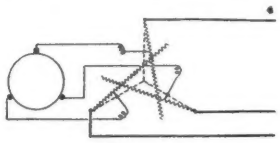


Fig. 10.

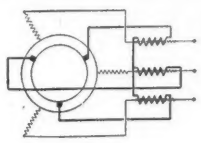


Fig. 11.

for commutation, which is effected solely by the resistance of the brush contact. It is very doubtful if a 200-h.p. machine could be built at all, except for very low speeds.

Altogether, the machine is very expensive and requires a large controller, and it is very unlikely that this type will be able to meet competition either in quality or in price.

The alternating-current series commutator motor is destined to play a not inconsiderable part in practice. In construction the stator is exactly similar to that of an ordinary induction motor; the armature is similar to that of a continuous-current motor. It is now usual, instead of connecting the stator winding directly in series with the armature, to introduce a transformer which reduces the voltage impressed on the armature; this is necessary to improve the commutating conditions, but it incidentally isolates the armature and commutator from the supply system, and therefore allows the stator winding to be designed suitable for a high-tension system.

The characteristics of this motor are much more comprehensive and varied than that of the continuous-current series motor. An a.c. series motor can exert any required torque over a considerable speed range, and this is rendered possible by the simple movement of the brushes round the commutator relative to the stator. At any one brush position the speed-torque characteristic resembles that of a continuous-current motor in many respects; over the working speed range an increase of torque is accompanied by a decrease in speed, and vice versa. At starting and at low speeds the current in a continuous-current motor is limited only by its internal resistance, whereas in an alternating-current motor it is limited by fluxes which produce an inductive drop. The alternating-current motor possesses the advantage that without series resistance it may possess a high starting torque and also give high running torque at top speed; any starting torque from the very lowest value to several times full-load torque may be obtained by merely shifting the brushes. With the brushes in such a position as to obtain low starting torque the standstill current is very small, hence it immediately becomes evident that under such conditions the machine may be connected directly to the supply system without the introduction of any starting devices. Any initial torque such as is required to start the load may be obtained by moving the brushes from the position of rest, and, in general, full-load torque is exerted with half full-load current, and other torques in proportion. The motor is quite unsuited for maintaining a constant speed under a variable load torque, unless the changes are very gradual and allow of a change in the brush position in the meantime, but for loads with torques which remain practically constant at all speeds, or torques which vary only with the speed, the motor is eminently suited.

Centrifugal pumps, blowers, and ventilating fans, and also reciprocating pumps and Roots blowers may be cited as examples. The torque varies approximately as the square of the speed in the first three drives, and for the others is practically constant over a wide range of speed. In the former cases the series commutator motor is capable of producing speed variation from standstill to the maximum value in a perfectly smooth and gradual manner. Instead of the inherent torque of the motor commencing to fall immediately the armature has started from rest, it gradually rises to a certain maximum which is slightly higher than the starting torque; then it begins to fall away in the usual manner as the speed increases further, until the torque falls to a value equal to that required by the load.

Generally speaking, a speed range of 3:1 under constant torque is the utmost limit for a series commutator motor. For all supply pressures above 200 volts it becomes necessary to interpose a transformer between the stator and rotor so as to reduce the armature voltage, but the capacity of the transformer is a fraction only of the capacity of the motor, and does not therefore add very seriously to the cost. Fig. 11 shows diagrammatically the arrangement which is employed.

Other applications to which this motor may be put are the driving of calendering machines and calico printing-presses. To a certain extent series motors are used for cranes and hoists, but as those required are usually of small capacity, these services are better provided for by the single-phase commutator motor.

The motor has an advantage over the ordinary induction motor in being able to operate at unity power factor at full

load and full speed; at low speeds under the same torque the power factor is slightly reduced, but still remains high; at lower speeds and torques the power factor falls off rapidly due to the great reduction in load, but it does not become worse than that of an induction motor of equal power at the same input.

Machines for low frequencies such as 25 cycles per second are easier to build, and may be made in slightly larger sizes than 50-cycle motors; the size of the commutator is almost proportional to the frequency, so that high-frequency motors are slightly more expensive. The upper limit of capacity of 50-cycle motors is in the neighbourhood of 100 H.P., and of 25-cycle motors 150 H.P.

The simplicity of construction of the series commutator motor, the ease with which starting and speed regulation are effected, the high efficiency at all speeds, and the good power factor over a wide range, are properties which are likely to make it of great service in many applications.

Another important application of the polyphase commutator motor is that of cascade connection with an induction motor.

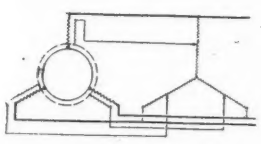


FIG. 12.

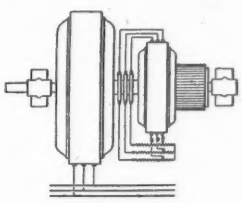


FIG. 13.

The machine may be either of the shunt or series type, but, unlike those previously discussed, must be capable of working satisfactorily over a wide range of frequency.

A commutator machine is the only one in which a gradual change in frequency does not necessitate a change in speed, and this is sufficient to explain its use in this connection.

A shunt commutator motor suitable for cascade connection embodies a compensating winding in series with the armature, and a separate shunt exciting winding which derives its excitation from the source of supply, preferably through an auto-transformer, so that the excitation may be varied at will and the phase of the voltage fixed in relation to that impressed on the motor terminals. A diagrammatic representation is shown in fig. 12.

For any one ratio of the exciting voltage to the terminal voltage there is one frequency only at which the machine will operate. This frequency may be altered conveniently by varying the ratio of the exciting voltage to the terminal voltage, and whatever the terminal voltage these relations hold good. By connecting such a machine in cascade with an induction motor, the slip-ring voltage as determined by the design of the motor is taken up by the shunt commutator motor, and the latter enforces a slip frequency only, according to the setting of its excitation. It will be evident that it becomes possible with an arrangement of this kind by varying the excitation of the commutator motor to impose a wide range of frequencies on the external circuit, which is the secondary of the induction motor, and, as previously shown, each frequency corresponds to a definite speed of the induction motor. Speed regulation

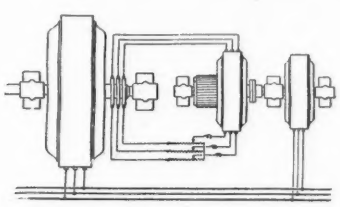


FIG. 14.

becomes, therefore, almost as simple as with continuous-current machines.

The commutator motor has to deal with the full secondary current, and a voltage which is fixed by the maximum slip frequency employed; a cascade motor, therefore, capable of producing x per cent. slip in the main induction motor must be designed for x per cent. of the latter's ratings.

Two methods of utilising the torque exerted by the commutator motor are in practical use. One suggested by Krämer is to couple the shaft of the commutator motor direct to that of the main motor, or to drive the auxiliary by a belt or gearing. This combination is illustrated in fig. 13.

The other method is due to Dr. Scherbius. The commutator motor is direct coupled to a squirrel-cage induction generator, which in turn is electrically connected to the supply system. Electrical energy given to the commutator motor at variable frequency is converted to mechanical work available on the shaft, and this is re-converted to electrical energy in the induction generator, and returned to the supply system. This arrangement allows a convenient speed to be adopted, which is practically constant under all conditions. It is illustrated in fig. 14.

By suitable design the main motor may be magnetized altogether by the commutator motor, and no wattless current will be taken from the supply system even on no load; or the main motor may be made to draw leading wattless current on all loads in a similar manner to a synchronous motor.

The power-factor characteristic curve, 1 in fig. 15, is typical of those obtained at many speeds during tests on a 500-H.P. 440-volt 40-cycle 12-pole induction motor, in conjunction with a shunt-excited commutator motor manufactured by the British Thomson-Houston Company. A few speed characteristics (Curves A) also bear out the conclusion arrived at from theoretical considerations.

The possibility of further improvement along these lines has been proved by following the suggestions of Milch. He pro-

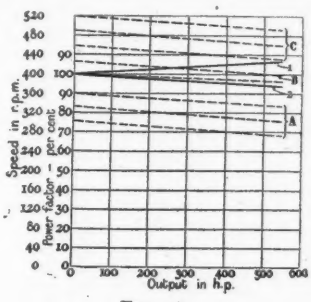


FIG. 15.

posed to employ the commutator motor as a commutator generator, and to run the induction motor above synchronous speed as well as below.

In order to pass the synchronous point it is necessary to obtain exciting current of proper frequency and phase from a source of constant magnitude, and independent of the actual value of the frequency. This may be suitably accomplished by the use of a small frequency converter.

This converter exciter, positively driven from the main motor, is connected to the field winding of the shunt commutator machine, and the voltage impressed naturally sets up a current in the armature of the commutator machine and the rotor of the main motor, the phase being such as to produce a torque and cause the machine to accelerate in speed.

The speed of the induction motor remains appreciably constant under load, and the characteristic obtained on test is shown in fig. 15, Curve B.

As it is unnecessary to continue separate excitation when there is a voltage present at the terminals of the commutator generator, it is replaced by self-excitation, the exciting winding being connected to its exciting transformer. Regulation of the speed of the main motor is carried on from this point by adjustment of the excitation of the commutator machine exactly as in the case for speeds below synchronism.

The arrangement of the B.T.H.-Milch system is shown in fig. 16.

Under load the commutator generator maintains practically constant frequency, any variation which takes place being due to the internal losses, and as is to be expected the speed of the

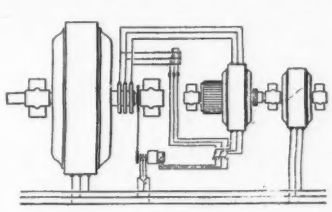


FIG. 16.

main motor drops slightly with load. Speed characteristics obtained during the same tests as the foregoing are shown in Curves C of fig. 15. The power factor of the main motor for all these speed characteristics is shown in curve 2 of the same figure.

The type of motor with a control system as described is only of practical service for large outputs. In small units it is much too expensive, but for large powers it becomes cheaper than a continuous-current motor and apparatus converting from alternating current to continuous current.

The limit of slip frequency is approximately 15 cycles per second, so that except for 25- and 40-cycle supply systems the amount of speed regulation is perhaps not so wide as would be desirable for some applications, and this may limit its possible field to some extent. Its use lies principally for unidirectional rolling-mill drives, and for this purpose it is admirably adapted. The speed characteristics shown in Curves A, B, and C of fig. 15 may be made to droop to any desired extent as load is applied by the simple superposition of series excitation on the shunt excitation of the commutator machine. A con-

siderable drop of speed between no load and full load is usually necessary for rolling-mill service in order to utilise energy stored in the flywheel.

The variability in the power factor of a brush-shifting series commutator motor precludes it from successful use in cascade with an induction motor. The machine which will be discussed has fixed brush position, and if run at constant speed has a fixed power factor under all loads and frequencies. Furthermore, the system of control has been made as simple as brush shifting.

The commutator machine must generate a voltage strictly proportional to the current passing through it and also at some predetermined phase angle to the current; this is accomplished by series excitation.

The commutator machine in part acts like a resistance, producing a slip proportional to the load. There are two essential differences between this and a resistance speed-regulation; one is that the energy input to the commutator machine, represented by the voltage at its terminals and the current passing through it, is converted to mechanical work, which may be utilised as desired, and secondly the current is not in phase with the voltage, which means that a wattless component is present. Naturally this component is used to advantage by making it of such a strength as to act as magnetizing current for the main motor, and thus to improve its power factor. In

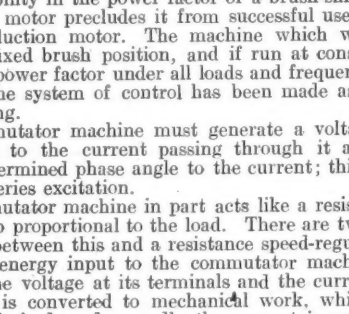


FIG. 17.

its simple form the series commutator motor, or slip regulator as it is termed, is a combined phase advancer and slip producer, the slip being proportional to the load.

To extend its sphere of usefulness it is desirable to be able to adjust the slip-producing properties so that any required slip for a given load may be obtained, and at the same time to retain the phase-advancer properties under all conditions.

For this purpose the stator of the commutator motor is fitted with a special 3-phase winding placed with a certain angular space relation to the armature with fixed brushes and connected in series therewith.

By a suitable arrangement of shunt to the stator winding or parts of it, a portion of the total current may be deviated from the stator, the shunted current bearing a fixed angle to the total current. It becomes possible by this means to vary the excitation, and therefore the flux and voltage of the commutator machine through any desired amount for any current. The shunt possesses principally reactance, and has a limited resistance; accordingly it takes a solenoid form with an iron core, and its variability is produced by movement of the latter. This simple operation, which is the only regulation necessary, causes the commutator machine to take up a wide

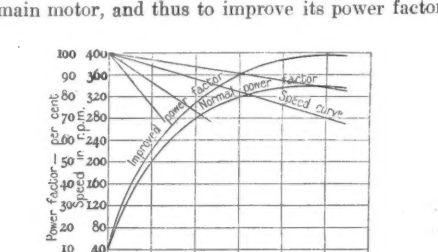


FIG. 18.

range of characteristics. The limits are approximately those of the shunt commutator motor, the maximum slip frequency being approximately 15 cycles per second; with a 50-cycle induction motor this allows a slip of 30 per cent. between no load and maximum load.

The characteristics shown in fig. 17 were obtained in the testing department of the British Thomson-Houston Company. The improved power factor at light load is not quite so good as can be obtained with a pure phase advancer, because saturation in the commutator machine cannot be allowed, but the improvement at full load, which really matters so far as the generating plant is concerned, is very considerable; the power factor also remains independent of the amount of speed regulation.

The slip regulator possesses a fairly large field of application. There are in existence at the present time a large number of induction motors which are controlled by resistance in the secondary circuit. In particular is this the case with motors driving rolling mills, and with flywheel motor-generator sets. The losses involved are often of considerable magnitude, and would represent a large saving if recoverable, but hitherto this has not been possible. The slip regulator converts not only 90 per cent. of the energy previously wasted into useful work, but at the same time improves the power factor of the induction motor with which it is used.

The application to a flywheel motor-generator set is represented by fig. 18. The commutator motor is mounted on the end of the shaft after the manner of an exciter, and its terminals are connected directly to the slip-rings of the main induction motor. As load comes on the motor the secondary current flows through the commutator motor, causing it to generate a counter electro-motive force of rotation which simultaneously causes the induction motor to slip. The electrical energy passing into the commutator motor is converted to mechanical form and given to the shaft of the set, thus serving a useful purpose; the amount of slip between no load and full load may be adjusted by simply moving the core of the solenoids which shunt the stator winding.

Another service is the regulation of an induction motor driving a ventilating fan, the torque of which is definite at each speed.

This type of equipment may be built for any output.

The Schrage type of motor combines an induction motor and cascade-connected shunt commutator motor in one.

Assume that the 3-phase primary winding of an induction motor is closed on itself, as would be the case in a continuous winding of the lap type; the tappings at which voltage would be impressed are 120° apart. The secondary winding on the

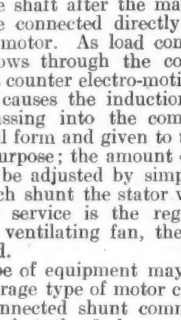


FIG. 19

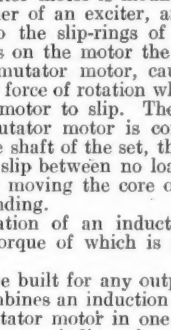


FIG. 20.

rotor is shown as three separate phases by AA_1, BB_1, CC_1, in fig. 19.

It has already been shown that to maintain a rotor speed lower than synchronism, there must be a counter electro-motive force supplied to the rotor phases of the same frequency and opposite in sense to the voltage induced in them by the slip of the rotor relative to the primary field. There is a very simple and effective method of accomplishing this without an auxiliary machine, as will be clear from the following:—

Let a stationary commutator be fitted to the stator winding, the junctions of the coils being connected to the segments. Any pair of brushes pressing on the commutator will have a voltage between them the value of which depends on the angular separation or spacing. The frequency of the voltage depends on the speed of rotation of the main field relative to the brushes, and if the latter are stationary it will be the full primary frequency. If the brushes rotate with the same spacing in the same direction in space as the main field, the

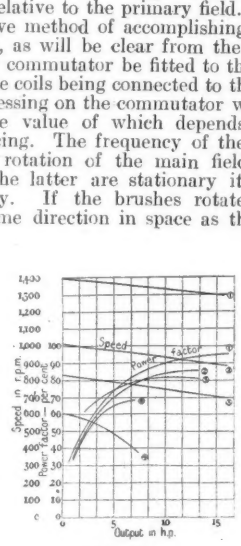


FIG 21.

frequency obtained will be smaller, but the voltage will remain constant. Obviously then if the brushes are fixed relative to the rotor, and rotate with it, there will always be the same frequency between them as is induced in the rotor phases, and the voltage may be varied at will according to the spacing. By ensuring that the voltage obtained in this manner between the pair of brushes is opposite in sense to that induced in one of the rotor phases by rocking the brushes bodily relative to the rotor and so altering the phase, the desired counter voltage for each phase is obtained.

When the brushes of each pair are moved together so as to coincide there is no voltage between them, hence there can be no speed regulation, but incidentally the rotor phases are short-circuited, and the machine may therefore run as a simple induction motor with short-circuited secondary. Separating the brushes produces a voltage and sets up a current which forces down the speed of the rotor until it is opposed by the slip voltage induced in the rotor. For each angle of separation of the brushes there is a definite speed. The machine has the ability to take load with very slight speed drop in precisely the same manner as an induction motor. A load torque retards the rotor, and the increased voltage induced exceeding the

counter voltage between the brushes sets up a secondary current which provides the necessary torque.

It will be observed that the secondary current flows in the same sense as the rotor voltage; the rotor is therefore giving up energy by conduction to the primary, to which there will be occasion to refer again. Reversing the position of the brushes is a natural extension of the operation, and the results produced are of fundamental importance. The voltage present between a pair of brushes is fixed by primary considerations, and is unalterable and uninfluenced by secondary voltages. By reversing the position of the brushes, and therefore reversing the sense of the voltage between them, the secondary voltage in the rotor phase is compelled to follow suit, and this necessitates that the rotor commence to rotate at a speed higher than synchronism. Under these conditions the torque-producing current in the secondary is in the same sense as the primary voltage derived from the brushes. Energy is therefore conducted from the primary to the secondary and converted to mechanical work.

It will be observed that the functions of the primary winding are two-fold; first it induces voltage and transfers energy through the medium of the main field to the secondary, after the manner of an ordinary induction motor; secondly, it acts as an auto-transformer and frequency transformer, and thus transforms and returns power (which is delivered to it by the secondary) to the system when the motor runs below synchronous speed, and transforms and conducts additional power to the secondary when the motor runs above synchronous speed. The power dealt with by the commutator and through the brushes is only due to the slip energy analogous to the power dealt with by a separate auxiliary shunt commutator motor.

To sum up the action, it may be said that the power induced in the secondary on the induction-motor principle corresponds to the mechanical output at synchronous speed under the torque considered, and if the speed be less than synchronous the secondary power is in excess of that used up in the mechanical form, and the difference is conducted back to the primary, where it is transformed and returned to the system. At speeds above synchronism the power induced in the secondary is less than the mechanical output, and the deficiency is made good by power conducted directly from the primary to the secondary. The electrical input therefore corresponds to the mechanical output, and the machine is highly efficient at all speeds.

The amount of speed regulation above and below synchronism is limited only by the power factor of the secondary circuit. This must be kept high, otherwise the torque for a given current will suffer. The power factor depends solely on the ratio of resistance to reactance; and the reactance is low so long as the frequency is low. On a 50-cycle circuit a slip frequency of 25 cycles above and below synchronism gives speed limits in the ratio of 50+25 : 50—25, namely 3 to 1, and for circuits with a lower frequency than 50 cycles per second the speed range is increased.

Reference has hitherto been made to a purely hypothetical machine since it is quite impossible practically to alter the spacing of brushes which are rotating in space. To utilise the idea, the primary and secondary must be inverted, the primary with its commutator must be wound on the rotating element, and the supply fed to fixed points on the winding through slip-rings, and the secondary must be wound on the stator as three separate phases after the manner of an induction motor, the terminals being connected to brush studs on two rockers movable in opposite directions as shown in fig. 20.

A still further modification is necessary in a practical machine. A straightforward primary winding after the manner of a rotary converter armature would have considerably too high a voltage per segment for satisfactory operation with a normal supply voltage. Two distinct windings are therefore used in transformer relation, the one connected to the commutator having few turns and carrying correspondingly higher current, whilst the other may be star or delta wound and connected to the slip-rings.

The practical limit of capacity for machines of this kind is in the neighbourhood of 70 H.P., and within this limit in the author's opinion it is the cheapest, simplest, and best variable-speed alternating-current motor with a shunt characteristic yet evolved.

The characteristics shown in fig. 21 are reproduced from the E.T.Z., four speed curves being given from the many obtainable within the complete speed range. The machine is essentially one which gives an output proportional to the speed, as may be readily deduced from its action above and below synchronism.

The motor is specially suited for driving machine tools, pumps, fans, blowers, paper-making machinery, and printing presses.

Discussion.

Dr. G. Kapp said the author had earned the thanks of the Institution for having brought a subject before it which had been neglected too long. To persons conversant with vector diagrams those given by the author were quite intelligible; and if they were dealing with asynchronous machinery no more would be required, for they had grown accustomed to read into the vector diagram the physical meanings represented by the different lines and angles. This physical meaning was however not so obvious in the diagrams representing commutator machines; he had found it useful for the understanding of treatises on commutator machinery to supplement the ordinary vector, or time, diagram by what was known as a space diagram. The distinction was that in a time diagram the vectors retained their lengths, but altered their positions, whilst in the space diagram the vectors retained their angular positions but altered their signs and lengths. The conventions he suggested were as follows, assuming all machines to be of the two-pole form:—

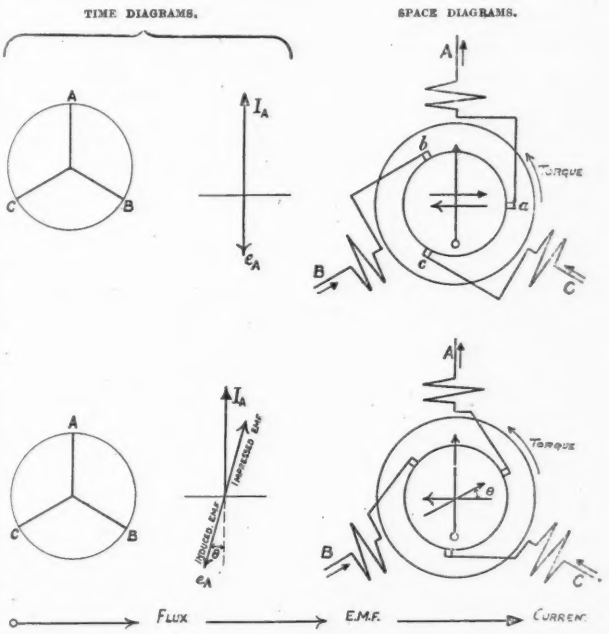
Sense of progression in the winding.—Stator and rotor are supposed to be wound in such way that a current passing in at one end and out at the other terminal (or brush) will produce a flux across the diameter in the same sense. In other words the exit terminal becomes a N pole. The flux produced is represented by a line parallel to the diameter of the winding. The length of the line represents the crest value of the flux. The direction of the flux is represented by an open arrow head. A little circle is to be placed at the other end of the line to show that it is a flux vector. The angular position of each flux vector does not vary, but where two or more fluxes are combined the angular position of the resultant flux vector changes. In other words the resultant flux vector rotates also in a space diagram.

Sense of rotation.—The time vectors rotate counter-clockwise. To make the resultant flux vector also rotate counter-clockwise in the space diagram the marking of the stator poles must be in a clockwise sequence.

Direction of EMF.—The direction of the EMF. induced in the rotor is obtained by revolving the flux vector through 90 degrees. The EMF. vector is represented by a line with open arrow head.

Current vector.—This is represented by a line with a closed arrow head. Its direction is given by the terminal diameter, its length and sign (whether to one side or the opposite side are read off the time diagram.

Direction of torque.—Consider the current vector as a lever, pivoted at its tail and weighted at its head with the field flux, then the direction in which the lever turns is the direction in which torque is exerted.



The application of these conventional rules is shown in the figures. The motor is supposed to be provided with a compensating winding so that no flux is produced by the armature current and the only flux vector appearing in the space diagram on the right is that due to the stator coils A B C. The figure on the left shows the phase position. It is chosen for the moment that the current in A has positive crest value. The direction of current in the space diagram is shown by the arrows placed to the field coils A B C and the resultant flux is shown across the armature by the vertical flux arrow. The brushes are placed at right angles to the coil axes and the resultant current through the armature is represented by the horizontal vector passing across the flux vector at right angles. This produces torque as shown by the curved arrow. The motion resulting from this torque produces the induced EMF. the space vector of which is also drawn at right angles across the flux vector, but with the arrow head on the left. Since an arrow head on the right of the current vector means a positive value (the current having positive crest value at the time) the space vector of the EMF. must be considered to be negative and in the time diagram the EMF. vector must be drawn in line with the current vector, but in the opposite direction. There is thus obtained for the A phase the very simple time diagram shown to the left of the space diagram. It consists of the current vector 1A and the vector of induced EMF. eA in exact opposition; which is the condition for the working of the machine as a motor. To supply the motor with current we must impress an EMF.

which has one component equal but opposite to eA; further a co-phasal component to cover losses and finally a component leading by 90 degrees to balance EMF. of self-induction. A motor with the brushes exactly at right angles to the respective field axes can therefore not work with unity power factor.

Assuming the brushes to be shifted forward by an angle θ as shown in the lower figure, the flux and EMF. vectors remain in the space diagram as they were, for these quantities depend on the position of the stator coils and these have not been altered. The only thing that has been altered is the direction of the current vector. It crosses the flux line at an angle which is by θ smaller than the previous right angle. There is this phase difference between current and indueed EMF., and that is shown in the time diagram by the two vectors being no longer in line but enclosing the angle 180 θ. The torque has been decreased in the ratio of 1 to cos θ, but a leading component eA sin has now been introduced and can be made to balance the EMF. of self-induction. The latter depends on the current and is independent of the speed; the leading component eA sin θ depends on strength of flux (therefore current) brush position and speed. It will thus be seen that only above a certain speed and load can the motor work with unity power factor and that by suitable choice of load, brush angle and speed the machine, whilst taking power from the line, can at the same time inject a leading current into the line so as to make up for the bad power factor of some other motor connected to the same line. If the brush angle be increased to 90 degrees the torque vanishes and the machine must be driven by external power. It then acts in the same way as a static condenser.

Dr. M. L. KAHN, whilst agreeing that the Latour motor might not be quite so good as some later machines, said that it was nevertheless a much better machine than the author stated. The first patent ever taken out on this type of machine was applied for in this country by one named Wilson, and consequently the machine was an English invention.

Mr. W. J. LARKE stated that the commutator difficulty was not the bogey that people imagined. The ordinary objection was inherited from experiences with D.C. machines and not experienced in practice with A.C. commutator machines. He also emphasized the advantages obtained from slip regulation.

Dr. A. H. RAILING remarked on the commercial advantages of three-phase commutator machines, and pointed out that when this type of machine reached a higher state of perfection the competition from the D.C. machines would disappear.

[On p. 245, through an accident whilst in the press, figs. 3 and 4 were inverted both in order and in position.—EDS.]

WORKERS' EARNINGS AND THE WAR.

By "COMMERCIAL."

If any proof were needed, the recent debate in the House of Commons indicated plainly that since the war began the prices of the necessaries of life have gone up considerably. As to the question of the temporary or permanent nature of such increases, for at any rate the period of the war, we are invited to wait and see. One can only trust that the waiting part of the arrangement will not be unduly prolonged, if only for the sake of the unfortunates upon whom high prices act most harshly, and that the seeing part of it will be as satisfactory as may be. We have had some experience of the consequences attendant upon a shortage of coal. From the industrial point of view dear coal, or no coal at all, may mean a measure of equal disaster. For domestic supplies it is indispensable to some, and nearly so to most people, but the approach of warmer weather will, if nothing else does, perhaps tend to lower prices. Food is, however, quite a different proposition, and we await with much interest the further investigation and discussion of this question, and the resultant Government action or inaction in the matter. We do know certainly that prices reached an artificial figure at the coming of the war, and people who were foolish enough, paid in some cases fancy prices for such an article as flour. Amid the confused array of arguments brought forward at the present time, bearing upon the increased cost of food, one cannot be dogmatic either in one direction or the other. It may be well to ponder rather on the question that concerns our power to buy food at the present prices. Will our wages, or salaries as workers, be able to stand the strain if present conditions remain, or perhaps grow worse? There are one or two indications about of some more or less ill-defined unrest, and, with no desire to be pessimistic, the evils of dear food might well cause such unrest to manifest itself in a most serious manner. In certain quarters industry booms, and work is better than has ever been known. The trades so affected are too well known to reiterate here, but labourers draw the wages of skilled artisans, and the latter twice the amount of their usual earnings, if not more. Electrical firms are sharing in this happy state of plentiful orders, doing day and night and Sunday work. Government orders are largely responsible for this, but the absence of the usual German supplies is another factor in the situation. Orders are pouring into this country from the neutral European nations, which cannot in some instances be filled for some time. It is not merely that Norway or Holland is ordering more than in other years. They are ordering material which is rarely, or never, in the normal run, obtained from anywhere save Germany. Beyond this, as can be seen from the pages of the ELECTRICAL REVIEW, the Colonies are doing their share, and signs are not wanting that they will maintain it after the war.

Outside the ranks of those firms who are thus fully employed there seems to be no serious slackness, and the absence of the hundreds of thousands of Kitchener's soldiers has doubtless relieved the labour market, where such slackness may have occurred. In some places, notably at our great ports, labour is very scarce, and presumably is worth more money to-day than usual. All this is to the good, but so far it only concerns those who are paid by the piece or the hour. Salaried workers are not having such a satisfactory time in some cases. In the first case certain firms took steps, immediately upon the outbreak of war, to reduce their staff wages. The reductions so made varied upon a sliding scale arrangement from 10 per cent. for the lowest, to 33⅓ per cent. for the highest paid of their employés. We make no remark upon the advisability or justice of such an arrangement, but merely mention the fact. These employés are now under the necessity of paying more for the maintenance of themselves and their dependents, if they have any, upon a seriously lessened income. It is not difficult to imagine the consequences of a 20 per cent. less income having to face a 25 per cent. rise in the cost of life's necessaries. At the best, salaries in the electrical world are, for several excellent reasons, generally no better than in other spheres of industrial activity, and in some departments of electrical work, to judge from certain evidence, they are occasionally worse. Some there are who predict that a slump will follow in the wake of the war. That is at least possible, if not probable. Now that slump will be the rainy day towards which the present boom ought to contribute something in the shape of a reserve. If, therefore, prices are to keep up their tendency, the staff wage should go up now. The worker receiving double money can pay 25 per cent. more for food and still save something, but the salaried man at a fixed, or reduced, rate is, as the Americans say, up against it. He has to accept the rush and overtime, which are at least partly occasioned by the needs of his country's Government for war materials; he has to pay the extra prices which prevail, but he has nothing extra as a set-off or recompense for either of these. The welfare of the staff workers is at least of equal importance to that of the other workmen, and yet just at the moment this seems to be accorded less recognition than it might receive.

As outlined above, this is the position of affairs with regard to the pay of the various workers at the moment. Generally speaking, the situation may be said to be quite as good as might have been anticipated under the abnormal circumstances which have prevailed since August last. Things are undoubtedly looking better for electrical people generally than they were twelve months ago. Further than that we cannot go, and the only course possible for a month or two seems to be to adopt the waiting and seeing arrangement to which reference has already been made.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Modern Wiring.

May I correct a reference on page 267 of your current issue? It is in the abstract of my paper on wiring and was due to the omission of a line in my typewritten copy. The sentence refers to the new system of concentrated cab-tire cable and should read as follows:—

"On a concentric conductor having a core of 3/22 S.W.G. and an external conductor of 36/30 S.W.G., the insulation resistance between the two wires was 1,700 megohms per mile, and the insulation resistance between the external wire and earth was 52 megohms per mile. This latter was the insulation resistance given by the impregnated tape plus the cab-tire sheathing."

As mentioned in my paper the cab-tire is not designed to give high insulation. Its good points are that it maintains well its initial degree of insulation. It gives, by its damp-resisting quality, more permanent value to any supplementary insulation beneath it; and it is a most excellent chemical protection to the whole cable. It is the latter qualities alone that are emphased by the makers of the cable. Yet, considered as a conduit, it has the inestimable advantage that no rush of current or even harmful leakage to earth can occur throughout its length. It is for these reasons that in its concentric form, it may be recommended, in combination with proofed tape or other light insulation beneath it, for use where the external conductor thus protected is normally at approximately earth potential. These conditions obtain where the external conductor is connected to the earthed mid-wire of a three-wire supply. Even in a two-wire system one side may be often usefully permitted to remain with only a moderate degree of insulation and difference from earth

potential. In such a case the cab-tire sheathing with its underlying reinforcement suffices to reduce stray currents to negligible dimensions.

Donald Smeaton Munro.

Edinburgh, *February 20th*, 1915.

[That there was an omission was obvious in the proofs, when going to press, but having no means of remedying it, we printed the matter exactly as received.—Eds. Elec. Rev.]

A.C. and D.C. for Lighting.

I must thank Mr. Fowler for the detailed manner in which he has replied to the points raised in my letter of recent date.

I am afraid that Mr. Fowler has misunderstood me in several cases, as shown for instance, by his remarks with regard to three-phase and direct current distribution boxes. For a given number of points, whatever the system of supply adopted, I cannot see that, allowing one fuse per point, the number of fuses, and hence, presumably the size of the box, will vary.

Again, it is surely not often that a three-phase distribution panel is used for lighting circuits? Is it not the best way to use a three-pole main switch with three single phase double-wound transformers, if the size of the installation warrants the use of more than single-phase distribution?

I regret that the wording of my letter with regard to "earth return" also conveyed a wrong impression—granted an *earthed* return, electrolytic action due to leakage current is still more likely to occur on D.C. than on A.C. circuits.

Mr. Fowler has overlooked the word "branch" when reading my remarks with regard to cables. By branch cables, I intended to imply the cables leading out of the distribution box, and not the main cables. It is usual to place the transformer close to the distribution box, in order to take care of this point.

I still maintain that Mr. Fowler is mistaken in his remarks about the diameter of the filament in wire lamps. If he will follow out the reasoning as follows, he will, I am sure, agree with me that his statement was made in error. The total candle-power given out by any lamp is the product of the "intrinsic brilliancy" and the area of the filament. Assuming that the diameter of the wire remains constant, the length of wire for a given candle-power, at a standard intrinsic brilliancy, must be a fixed value.

As the low-voltage lamp must obviously have a lower resistance than the high voltage lamp, the above conditions are not fulfilled as, in order to give the standard intrinsic brilliancy for a reduced voltage, either the length of wire must be decreased, or the diameter increased. The first alternative gives a lower total candle-power, the second (within certain limits) giving the correct result.

Perhaps Mr. Fowler has been told that the diameter of say a "40-watt" filament for a 250 volts supply is the same as for a 220 volts supply. This is, I believe correct, but it does not extend to such a wide range as that mentioned by Mr. Fowler.

In conclusion, I would like to say that my remarks were primarily concerned with indoor lighting, and not with "temporary work," and that by "general handiness," I endeavoured to express my opinion that A.C. supply was more adaptable than D.C. to varying conditions and requirements as they occur in lighting practice.

C. A. Hall.

Monkseaton, *February 18th*, 1915.

High and Low Voltage Metal-Filament Lamps.

Referring to the letter of Mr. Henry Fowler, electrician-in-charge, Liverpool, in your issue of the 12th February, in reference to A.C. versus D.C. for lighting, it seems very strange that a man who occupies a position of electrician-in-charge should be led into making such mistaken statements as he does on the question of the filament diameters of high and low volt lamps. He appears to be doubtful whether there is any difference between the filament diameter of a 110-volt lamp and that of a 220-volt lamp.

It would seem as if the simple application of the well-known electrical laws of resistance would indicate to him at once that the filament of a given candle-power lamp in 220 volts must be considerably smaller—a proportion of about one-half of the diameter of the same candle-power lamp in 110 volts. He ought to further understand that candle-power is not a matter of thickness of filament, but a matter of filament surface for any given material and temperature (or efficiency) at which it operates.

Nela.

Consulting "Engineers."

In reply to "Delta," I should prefer a consulting "engineer" who knows he knows nothing, shuts his mouth, and leaves himself in the hands of a few good firms, to one who apparently has never heard of apparatus which has been in general use for many years, and which is actually installed in his jobs (directly after the term of maintenance is passed) by the man who does not want commission so much as rest at night.

We still have installed 20 voltmeters in parallel on the same bus bar, lead-covered cables behind switchboards, and networks which are linked up solid, switches on every lamp-post and distributors on one side only of busy streets, insufficient and badly arranged plant and no provision for extension, together with all the little drawbacks so well known and inseparable from the standard specification made to suit every job.

How many consulting "engineers" could run and manage the jobs which they cause to be installed?

The fact of the matter is that no man should be allowed to practise as a consulting engineer unless he has passed through the proper training and quite stiff examinations, and the parasites referred to above would then be got rid of.

Alpha.

Half-Watt Lamp Fittings.

We were very interested in the article on Half-Watt Lamp Fittings by "Research" in your issue for February 12th. The question of the proper use of half-watt lamps is a very important one. The publication of the article referred to should be very useful to users of these lamps. We have had instances brought to our attention where the use of half-watt lamps in badly designed fittings has resulted in cracking the globes of the fitting and general unsatisfactory working. It must be appreciated that the very best results can only be obtained from half-watt lamps if they are properly installed in well ventilated fittings. It is not sufficient to put them into any type of lantern, the only ventilation of which is a hole in the bottom of the glass globe. The heat from the half-watt lamps necessitates considerably more efficient ventilation than this, and lamp users are urged to select only fittings made by those manufacturers who have a full appreciation of the necessities of the case

"Research" is correct when he states that probably the best results obtained with half-watt lamps are obtainable with the indirect lighting system. This company's indirect lighting fittings have been used in a number of cases, and the resultant illumination is wonderfully agreeable, attractive and effective.

In the last paragraph of the article your contributor mentions the need for an adjustable lamp-holder. It may interest him and your readers to know that such an adjustable lamp-holder for half-watt lamps is illustrated and described in our price list of weatherproof fittings, etc., for half-watt lamps.

The British Thomson-Houston Co., Ltd.

London, E.C., *February 16th*, 1915.

Trouble with Oil.

A 1,000-kw. set, D.C., driven by a Belliss & Morcom engine, is giving considerable trouble throwing oil. An oil baffle is fitted on the tail bearing, making a tight job so that no oil can possibly get through the commutating end of the machine, and while the shaft is quite dry, oil is found in considerable quantities inside the commutator, and thrown up through the armature windings. The conclusion come to is that the oil is carried in in the form of vapour from the engine, and condensed inside the machine. Have any of your readers had trouble of this sort? and what steps have been taken to get over it?

Enquirer.

Electrical Patents owned by Alien Enemies.

In the list under the above heading on page 271 of your issue of to-day's date, I notice that patent No. 18786 of H. Bremer, Neheim/Rhine, electric lamps, is included. This patent is not owned by an alien enemy but the British Westinghouse Electric and Manufacturing Co., Ltd., of this address, having been assigned to them in the year 1906.

It is somewhat astonishing to find such a glaring error in a list of this nature as the patent in question is one of some notoriety, having been the subject of two actions of infringement in which the British Westinghouse Company were the successful plaintiffs. These actions attracted at the time a considerable amount of attention in the electrical world.

The Westinghouse Patent Bureau.

(A. S. Cachemaille, *Joint Manager.*)

London, W.C., *February 19th*, 1915.

In the list of British patents originally owned by residents in enemy countries which appeared in your issue of 19th February, we inadvertently omitted to point out that subsequent assignments, recorded or otherwise, of the patent rights may have been effected, and that the official register should be consulted.

Mr. A. S. Cachemaille, C.P.A., informs us that the patent of Bremer No. 18786 of 1902 has been assigned to Messrs. The British Westinghouse Electric and Manufacturing Co., Ltd., and requests us to make this known, which we have much pleasure in doing.

W. P. Thompson & Co.

London, W.C., *February 22nd*, 1915.

A Quarter-Turn Coupling.

In your issue of February 19th of the ELECTRICAL REVIEW, on page 248 you describe a quarter-turn rod coupling "invented" by a Chicago engineer to replace a noisy bevel gear drive on a pump.

It may interest you to know that there is in the engineering department of the University of Leeds a small model of this coupling. This model was there when I entered the University over five years ago, and consequently the arrangement cannot be considered new.

Arthur Rawling.

London, E., *February 20th*, 1915.

Salaries of Junior Engineers.

In reply to "Driver" regarding the salaries and knowledge of some of these engineers, it is simply preposterous that a great number of these wasters, who, as "Driver" says, know nothing, get the chief post. I entirely agree with all that "Driver" says, by my own experience, which is long and varied. For instance, a year ago I went to a place where there were two large suction gas engines, and electrical plant on an elaborate system. At this place the engineer in charge happened to be no more than a common labourer. The whole installation had to be remodelled. I never saw such a state of affairs; everything had been abused to the utmost; in fact, it was in such a state that I refused to do the repairs till experts had seen it. The firm came that put it down, next came two more good men, and the architect, and they all agreed with me that the man was not efficient, yet the firm who put the plant down, supplied this "chief engineer," at a good salary. I was asked to put the whole thing into good working order, which took five months. The job had only been put down two years, yet it ran into hundreds of pounds to repair the damage done by an incompetent engineer, or shall I say a novice? I hope I never have another job like it; the damage done, if I were to describe it, would fill a small book. After the job was finished I left it to the satisfaction of all parties concerned, and I believe that the "engineer" had the order to quit, and time too. I myself was pushed out of a job to let the waster in.

Old Reader.

In reply to your correspondent "Driver," might one inquire how many years ago the cases he quotes took place? For we all know central stations were in a very slack condition 15 years ago. Also we may presume from "Driver's" description of the station, that the engineer-in-charge was receiving the magnificent salary of 25s. per week, and had probably come straight from a technical college, so the officials who engaged him, undoubtedly deserved the results, and then "Driver" asks: what kind of engineers-in-charge do you call these? "Duds," and we frankly admit it, for they lack experience; but there are "duds" in all grades of the station from the volt boy to the chief, including "drivers." I quite agree with "Driver" when he says that all these troubles could have been prevented if they had had an experienced engineer, but can you expect an experienced engineer for the paltry salaries we see advertised in the ELECTRICAL REVIEW's situation vacant columns for engineers-in-charge? Last, but not least, I really cannot imagine the average driver, or stoker, working out indicator diagrams, CO_2 and water recorder charts, boiler and coal tests, etc., or even the volt boy's daily load curve; they are usually more efficient at calculating the correct weight for a mile handicap or how much there is to come from a "tanner" each way on a six to four on chance. Not that I wish to cast a slur on drivers or stokers, for I have always found them very good men at their jobs, so if you have got on in the world, "Driver," my advice is, don't let your brains run away with your pen.

Honi soit qui mal y pense.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

1,973. "Electro-optical cells." C. STILLE. February 8th. (Convention date, February 6th, 1914. Germany.) (Complete.)

1,995. "Means for setting selecting-devices by electric current impulses." O. IMRAY. 8th February. (Siemens & Halske Akt. Ges., Germany.) (Complete.)

1,997. "Telegraph machines." L. M. POTTS. February 8th. (Complete.)

2,004. "Lamps for use with gas, electric, or other lights." J. A. CHELL. February 8th.

2,008. "Magnetic case for bomb." W. J. DEUSBURY. February 8th.

2,012. "Electrically-heated bodies." T. KIRKLAND & T. J. R. KIERNAN. February 8th.

2,014. "Electric control apparatus." A. H. CURTIS & IGRANIC ELECTRIC Co., Ltd. February 8th.

2,020. "Manufacture of neon vacuum tubes." G. CLAUDE. February 8th. (Convention date, February 12th, 1914. France.) (Complete.)

2,036. "Portable dry-battery electric torches." M. H. GOLDSTONE. February 9th.

2,045. "Electric accumulators." J. P. HAWORTH. February 9th.

2,057. "Electrical transmitter diaphragms." B. A. PILKINGTON. February 9th.

2,060. "Means for and methods of changing the frequency of alternating electric currents." A. M. TAYLOR. February 9th. (Divided application on 15,729/13. February 9th, 1914.) (Complete.)

2,076. "Wireless aerial elevator." C. TUCKFIELD & W. G. DE FORGES GARLAND. February 9th.

2,078. "Coin-freed electric illuminating-apparatus." H. E. STILES, known as L. STILES, and A. H. F. PERL. February 9th.

2,093. "Amplifiers of electrical energy." WESTERN ELECTRIC Co., Ltd. (Western Electric Co., United States.) February 9th. (Addition to 275/15.) (Complete.)

2,130. "Gas and electric light protector." G. HOBBINS, trading as V.C. LIGHTING Co., & W. HUNT. February 10th.

2,132. "Automatic electrical fuse-replacer." M. TERRY. February 10th.

2,144. "Process for the manufacture of metallic strips and ribbons by electrolytic means." S. O. COWPER-COLES. February 10th.

2,145. "Electro-deposition of alloys." S. O. COWPER-COLES. February 10th.

2,148. "Telephone apparatus." W. MARTIN. February 10th. (Kelly M. Turner, Jamaica.) (Complete.)

2,163. "System of telegraphy." E. C. R. MARKS. February 10th. (Delany Foreign Co. United States.) (Complete.)

2,164. "Telegraphic apparatus." E. C. R. MARKS. February 10th. (Delany Foreign Co. United States.) (Complete.)

2,180. "Switch panels." IGRANIC ELECTRIC Co., Ltd. February 10th. (Cutler-Hammer Manufacturing Co., United States.) (Complete.)

2,224. "Incandescent electric lamps." W. HUGGETT. February 11th.

2,236. "Electric pedal switches." R. BOSCH (Firm of). February 11th. (Convention date, July 29th, 1914. Germany.) (Complete.)

2,248. "Electric welding." E. I. HEINSOHN. February 11th. (Convention date, February 21st, 1914. United States.) (Complete.)

2,250. "Convertible electric fire." E. A. WELCH. February 12th.

2,259. "Means for and method of increasing the current-carrying capacity of cables carrying alternating or direct currents." A. M. TAYLOR. February 12th.

2,289. "Means for gripping electric cables and the like." W. T. HENLEY'S TELEGRAPH WORKS Co., Ltd., & H. SAVAGE. February 12th.

2,312. "Electrical heating-apparatus." A. F. BERRY. February 12th.

2,324. "Electric ceiling-roses and the like fittings." M. J. RAILING & T. TAYLOR. February 13th.

2,328. "Electric switches or devices for making or breaking electric contacts." F. H. HUMPHREYS, B. A. QUINT, & E. J. FELT. February 13th.

2,329. "Controlling polyphase electric motors." B. G. LAMME. February 13th. (Convention date, February 25th. United States.) (Complete.)

2,337. "Insulation testing devices for electric lighting and power installations." R. H. GOULD. February 13th.

2,341. "Generation of electrical energy." G. C. PILLINGER. February 13th.

2,343. "Telegraph or like systems and apparatus therefor." AUTOMATIC TELEPHONE MANUFACTURING Co., Ltd., & S. R. SMITH. February 13th.

2,344. "Bonding connector for bonding the armouring of cables." C. J. BEAVER & E. A. CLAREMONT. February 13th.

2,349. "Method of establishing a voltaic arc between electrodes not in contact." F. C. UCAR. February 13th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1913.

8,361. CHANGEABLE SIGNS. G. E. Wertheimer & Orograph Process and Radiant Sign Co. November 10th. (November 10th, 1913.)

19,875. APPARATUS FOR RECORDING THE CONTROL AND WORKING OF MACHINES BY THEIR OPERATIVES AND THE LIKE. W. C. Johnson. September 2nd.

26,082. CONTROLLING-APPARATUS FOR MOTOR-CARS. Lancia & Co. November 13th. (July 5th, 1913.)

26,855. ELECTRICALLY-CONTROLLED RAILWAY BLOCK SIGNALLING AND APPARATUS THEREFOR. P. Browne. November 22nd.

26,897. PROPULSION OF AERIAL OR WATER VEHICLES. J. Macinante. November 22nd.

27,174. PROPORTIONAL FLOW METER. W. J. Mellersh-Jackson (Cutler Hammer Manufacturing Co.). November 25th.

28,421. HOLDERS FOR ELECTRIC INCANDESCENT LAMPS. R. Doi. December 9th.

29,756. ELECTRIC CABLES. J. F. Watson, & Callenders Cable & Construction Co. December 24th. (Cognate applications, 1850/14 and 8828/14.)

29,757. MANUFACTURE OF ELECTRIC CABLES. J. F. Watson, & Callenders Cable & Construction Co. December 24th. (Cognate application, 1851/14.)

29,759. ELECTRIC RAILWAY SYSTEMS. K. E. Stuart. December 24th.

1914.

1,613. PUMPING AND SPRAYING APPARATUS FOR CLEANING A VARIETY OF ARTICLES. W. Routledge. January 21st.

1,759. RAILWAY SIGNALLING. C. M. Jacobs. January 22nd. (Cognate application, 3966/14.)

1,776. INDICATORS OR ALARUMS FOR DENOTING THE WATER LEVELS IN STEAM AND OTHER BOILERS. F. A. Young. January 22nd.

1,877. ALTERNATING CURRENT ELECTRICAL INSTRUMENTS OF THE MOVING COIL TYPE. R. D. Gifford, & Nalder Brothers & Thompson, Ltd. January 23rd.

1,970. TELEPHONE SYSTEMS. Automatic Telephone Manufacturing Co., and A. B. Sperry. January 24th.

2,063. ELECTRIC BATTERY LAMPS. F. J. Turquand. January 26th.

2,528. VEHICULAR ELECTRIC LIGHTING SYSTEMS. L. Renault. January 30th. (February 15th, 1913.)

2,679. METHODS OF CONTROLLING DISTANT APPARATUS BY HERTZIAN WAVES. J. H. Hammond, Junr. February 2nd. (Addition to 13,310/13.)

2,713. GLOBE HOLDERS FOR ELECTRIC, GAS, AND OTHER LAMPS. J. A. Shaw. February 2nd.

2,740. METHOD OF PRODUCING ELECTRIC IMPULSIVE DISCHARGES. R. C. Galletti. February 2nd.

2,746. EXPEDITING AND SAFEGUARDING RAILWAY TRAFFIC. H. A. Thompson. February 2nd.

2,827. ELECTRIC TRAIN LIGHTING, VENTILATING, AND HEATING SYSTEMS AND THE LIKE. J. Stone & Co., & A. H. Darker. February 3rd.

3,359. MACHINE TELEPHONE-SWITCHING SYSTEMS. Western Electric Co. (F. T. Woodward, acting for Western Electric Co.). February 9th.

7,241. SIGNALLING APPARATUS, MORE ESPECIALLY FOR USE IN COLLIERIES. John Davis & Son (Derby), Ltd., & W. H. Davis. March 23rd.

8,204. MEANS OR APPARATUS FOR TESTING EGGS. W. Walker. April 1st.

8,407. TUNE INDICATORS FOR AUTOMATIC PIANOS AND LIKE INSTRUMENTS. S. G. Smith. April 3rd.

9,093. ALTERNATING CURRENT ELECTROMAGNETS. Waygood-Otis, Ltd., H. P. Amphlett, & H. C. Walker. April 9th.

15,380. SPARKING PLUG. Soc. Carpentier, Bal., et Cie. June 26th. (January 22nd, 1914.)

18,829. ELECTRICAL STARTING-MECHANISM FOR INTERNAL-COMBUSTION ENGINES. F. H. Royce & Rolls-Royce, Ltd. August 19th.

20,796. ELECTRIC SWITCHES. F. B. Holt & H. Smith. October 9th. (Divided application on 25,833/13. May 11th, 1914.)

20,958. AUTOMATIC ELECTRIC FUSE. O. Johnson. October 14th.

23,894. CONTROLLING-SYSTEM FOR ELECTRIC MOTORS. G. R. Radley. December 10th. (Divided application on 1975/14. January 26th.)